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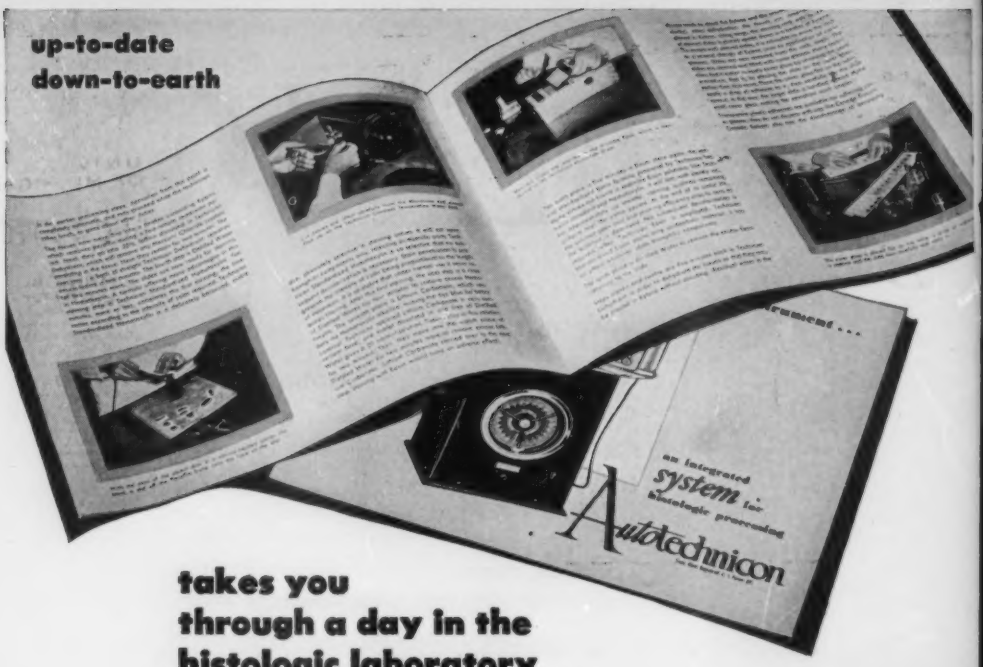

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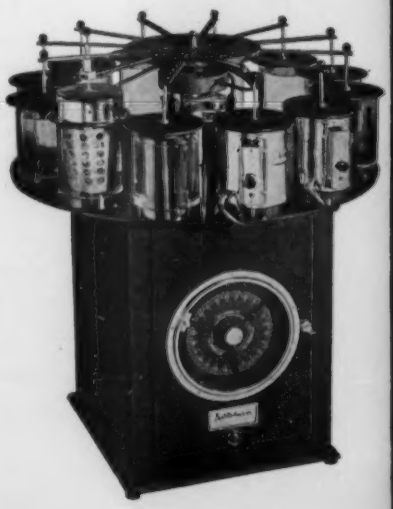

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The Food and Agriculture Organization of the United Nations

FULLY three-fourths of all the crops produced in the United States trace back to introductions from other countries. All of the principal types and breeds of domestic livestock in the U.S. are of foreign origin. Even those breeds that might be said to have been developed in this country are derivatives of foreign stocks used in breeding. Many of the techniques used in advancing agriculture in the U.S. are of foreign origin, e.g., pasteurization, and most animal disease-control measures. To these and many others add such important items as penicillin and DDT.

These enormous benefits to our agriculture—these bases for abundance in our food supply—were derived from many sources, throughout many years, by divers routes. Some of them, such as corn and tobacco, came to us incidental to the discovery of America. Some came in the luggage of early immigrants. Some were sent by alert travelers in other lands, as missionaries. Many of them are the result of purposeful endeavor, as the systematic plant exploration and introduction sponsored for more than a century by the U.S. government. Then, too, there must be included the many benefits that have flowed to us as the result of scientific and technological advancement in the world generally.

The U.S. has done a remarkably good job in adapting and developing introduced materials and techniques to the varied requirements of this country; and, through its own research and development activities, it has contributed notably to the advancement of knowledge which has been shared freely with other countries.

International cooperation, however informal, has been an influence of tremendous magnitude in this spread of materials, ideas, and experience. It has not been the only influence. Sometimes the might of conquerors, sometimes exploitation, sometimes sheer intrigue have influenced the spread. But in our own case, the courtesies of nations, and the willing cooperation of institutions and sympathetic individuals within those nations, have played a leading role. International cooperation with us has been a two-way street which has produced mutual benefits for all participants.

Yet even in our own case, international cooperation for the most part has been somewhat intermittent and lacking in the design that our advancement now permits us to visualize as the resultant of more formal, consistent procedure. We realize more than ever before that some of the food and agriculture problems still confronting us require for their solution the most suitable materials and the most advanced techniques which may come from outside as well as from within our own borders. Their importance to us gains emphasis as we regard our possible requirements a generation or more hence, as population presses increasingly upon our resources.

It is important, therefore, that we keep prominently in mind the potential of international cooperation, especially as it may be stimulated and facilitated by organized international purpose designed to promote the well-being of people in all countries. By helping other nations to help themselves we can in turn help ourselves; indeed, we can continue to be a principal beneficiary of cooperation.

In this frame of thought the Food and Agriculture Organization of the United Nations looms large as a potentially valuable medium through which cooperation in this field may be encouraged and developed. For FAO is the one international organization whose primary function is to promote such cooperation. Although only eight years old, it has made commendable progress. It has gained needed experience, clearer comprehension of problems, and knowledge of the people confronted by those problems. Continued gains of that type will benefit all countries, including the advanced as well as the underdeveloped countries.

The continuity, solidity, and security of FAO as an international institution around which to further international cooperation in the field of food and agriculture command the interest and serious consideration of 68 nations assembled in Rome for the seventh session of the FAO Conference (Nov. 23–Dec. 12). Among those nations none is more interested or more concerned about the future of FAO than the United States. It is gratifying to know that the official position of this country is wholeheartedly behind the Organization.

P. V. CARDON

U.S. Department of Agriculture
Washington, D. C.

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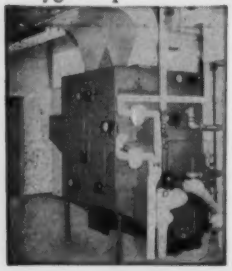

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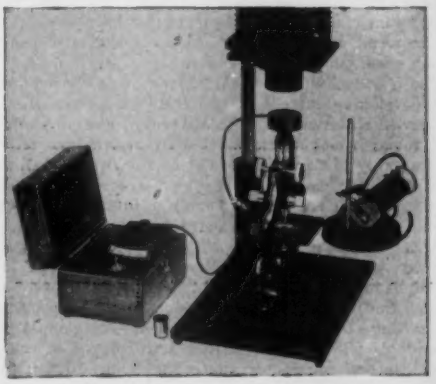

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Wanted: A Single Purpose Nuclear Power Program[1]

George L. Weil

1025 Connecticut Avenue, N.W., Washington, D. C.

IT IS AN HONOR for me to be invited to participate in this Conference on Nuclear Engineering, particularly since my relationship to the field is more in the nature of a Sidewalk Superintendent compared to the intimate activities represented by the other contributors.

Like many of you here, I was brought up on the classified Information Meetings held behind guarded doors and open only to the Q-cleared. In contrast to that atmosphere, the openness of this meeting is refreshing. It is characteristic of what I hope represents the beginning of a new era in the field of reactor development. Although a great deal of technical information on reactor engineering is still guarded, I am convinced that this 1953 Conference will demonstrate that there is much of importance to the program that can be freely, openly, and usefully discussed, and that this will be followed by further unclassified conferences with an ever expanding area of technical discussion.

This new era is reflected in more open discussion of the numerous issues affecting the national interests which are involved in the development of nuclear power. One can scarcely pick up a daily paper or a magazine without finding an article on this subject. The recently completed series of open hearings before the Joint Congressional Committee has contributed greatly to the availability in the public forum of facts and views.

The development of the peaceful uses of nuclear energy touches upon many facets of our national life, including our economic welfare, our security, and our international relations. The formulation of a devlopment program in the best interests of the nation as a whole must be based upon the relationship of nuclear power to these aspects as well as upon technical considerations.

Reactor scientists and engineers have a special desire to push ahead with a vigorous program of nuclear power development, to put design conceptions to practical test, to move on to the next generation of technical problems. The point of diminishing returns has been reached in so far as technical-economic paper studies are concerned. The barriers currently faced in moving ahead are not technical. They stem rather from political and economic considerations. There is no dearth of proposals covering technical and financial approaches, but there is indecision as to which, if any, should be pursued.

The formulation of a realistic development program involves five elements: first, the specification of our national objectives; second, the specification of performance goals; third, a schedule for achieving these goals; fourth, specific technical approaches; and fifth, last but not least, a source of financial support. I would like to make a few brief remarks on each of these subjects.

National Objectives and Short-Term Program. Granted that it is technically feasible for us to produce nuclear power, the question we face today is should we press forward with its development as a competitive industrial process? It is necessary to have a clear understanding of our interests and objectives in order to formulate policies relating to the type of technical programs we should support, the schedules we should meet, and the designation of primary responsibilities for their execution. The lack of precise formulation of these policies is the cause of the indecision which exists today in our nuclear power program. The industrial and other proposals that have been submitted to the AEC have little basis for comparison among themselves. All have merits, but their specific provisions, technical and other, are based on different individual motivations or objectives, on different performance specifications, and on different appraisals of technical difficulties. Only the framework of our national interests and goals can provide a common ground for evaluation of different approaches.

For the purpose of having them clearly in mind, I will briefly enumerate our national interests in the development of nuclear power. Leaving aside the special military interests in stationary power plants, the benefits that this country can derive from the development of a practical nuclear power technology are of two kinds—what I call direct and indirect.

The direct benefits would derive from effects on our own industrial economy resulting from three conditions, namely, the availability of an additional source of energy for public and private use to meet expanding requirements, a greater flexibility in the selection of plant design characteristics to meet special situations, and the possibility of more effective utilization of the natural resources available directly to us.

The indirect benefits would derive from interactions on our own welfare from enhanced national prestige, expansion of our areas of technical assistance to our allies and other friendly nations, and a greater flexibil-

[1] Invited paper presented at the 1953 Conference on Nuclear Engineering, University of California, Berkeley, September 11, 1953.

ity in our capabilities to promote the well-being and strength of the free world.

The importance of making the distinction between direct and indirect benefits lies in the difference in time scale associated with realizing results. I do not have to elaborate on the fact that this country is well supplied with both natural resources of conventional fuels and efficient public and private utility concerns, a combination which assures us of ample low-cost electric energy for at least the next twenty-five years, and probably longer. On the other hand, the power situation is more acute in many foreign areas, including both highly industrialized and underdeveloped. Even accepting some of our more pessimistic estimates of the cost of energy from nuclear plants based on our present technology, it would appear that nuclear power might be of practical industrial use in certain foreign areas in the relatively near future, if not today, if it were available.

Just how, and where, and when we might be of help to other nations in the development and use of nuclear power is not too clear at this time. Our present legislative policies impose strict limitations to such actions. There are many unknowns with regard to developments in the international scene which might influence our future national policies in this area of activity. However, it will take time to develop our technology to the point where we can not only realistically evaluate the potentialities of nuclear power as a short-range element in promoting the industrial economy of our allies, but also be in a practical position to provide substantial technical aid if circumstances permit.

These considerations lead us to three conclusions: first, we, as a nation, have incentives to support a short-term program to develop practical nuclear power plants based on our present technology; second, the specifications for design and performance of the plants should be formulated to assure flexibility in potential applications; and third, primary responsibility for a program should be assigned to either or to both public and private organizations that are motivated by the short-term objectives and that can afford to assume the financial burden without regard to tangible profits in the near future.

Thus, the existence of indirect benefits provides us with incentives to invest technical effort and money in a development program that has little likelihood of showing substantial short-term direct benefits to this country's economy. This immediate program is an opportunity for us, not an urgent necessity. It will not mean the difference between survival or destruction of the free world. Further, although such a program would allow us an earlier start on meeting our long-term needs than could otherwise be economically justified, it would not significantly enhance our ability to meet energy requirements fifty or one hundred years from now.

The Technical and Economic Aspects of a Long-Term Nuclear Power Development Program. If we identify the major performance specifications that must be met by nuclear power plants if they are to contribute substantially to this country's energy demands, I think many would agree that we have a long hard technical development program ahead of us. We must shoot for a plant design that can not only provide for future energy demands at economic production costs but also provide the fissionable material inventory required for new plants needed to meet the forever expanding energy requirements. This means a plant that has minimum annual fuel requirements (consumes 100 per cent of feed material) and an inventory doubling time of the order of ten years. More specifically, the nuclear plant of the future must have a high breeding factor, a high specific power, or low fissionable material inventory, a high fuel burn-up per cycle, low cost fuel and fertile material processing, low investment in plant and equipment per kilowatt of generating capacity, safety of operation, long plant life, and reliability of performance. The achievement of these performance specifications will require improvements in our present estimated capabilities by several orders of magnitude.

The type of plant that is envisaged as the prototype of a large-scale nuclear power industry is usually referred to as a "breeder." The accepted technical definition of a breeder is a plant that produces more fissionable material than it consumes. I, of course, agree that a large breeding factor will be a necessary design characteristic of a future efficient nuclear power plant. However, since this characteristic is only one of a number, I think it is misleading and oversimplifying to use it as the basis for deriving a generic term to describe plants having highly developed overall performance efficiency.

From my reading of the unclassified scientific literature, the daily press, popular magazines, and professional journals, I gain the impression that the breeder has become, in many people's minds, the symbol of the quick and easy solution to the world's energy problems. A decade ago the words "atomic energy" occupied this position. But now that we are face to face with the specific technical and economic problems of current designs the symbol has been transferred to something equally vague, "the good breeder."

Part of the ballyhoo for the breeder is the claim that only this type of plant can give negligible nuclear fuel costs. The commonly quoted figure is 0.013 mill per kilowatt-hour. How negligible can we get? On the same basis of calculation, a nonbreeder with a feed utilization of only 10 per cent would have a fuel cost of 0.13 mill per kilowatt-hour, which for all practical purposes is also negligible. The fact is that any excess fissionable material produced by breeding has no effect whatsoever on the cost of the energy in the fuel. So far as the energy in feed material is concerned, one cannot do better than consume 100 per cent of it, and this is achieved with a plant that produces fissionable material in an amount exactly equivalent to that consumed, in other words, by definition, not a breeder. More important, the practical fuel costs per kilowatt-hour will be determined by the cost of reprocessing associated with utilization of the feed material, again

independent of the breeding efficiency. If high values of fuel burn-up and low reprocessing costs can be developed for plants with large breeding factors, the same techniques can be applied with comparable economic gains to plants with small breeding factors and even nonbreeders.

The only true significance of a plant that produces more fissionable material than it consumes is the fact that it can provide for the inventory of new plants. This means that power production from nuclear plants can be expanded without resorting to the presumably more expensive method of obtaining the needed fissionable material for inventory from other sources, such as diffusion plants. However, here again the practical efficiency of a plant in producing excess fissionable material depends upon more than its breeding characteristics. It depends just as critically on the specific power.

On the basis of any desired set of performance standards, we can have good breeders and poor breeders, as well as good nonbreeders and poor nonbreeders. Each type will probably play a role in the long-term development of a nuclear power industry. There will be little difference between a good nonbreeder and a poor breeder with respect to design, performance, economics of energy production, or demands on raw materials for fuel or for plant expansion inventory.

With regard to the stages of development of nuclear power plants, I would expect a gradual improvement in plant performance characteristics, particularly breeding factor and specific power, at a rate determined by the availability of raw materials at economic prices and the incentives to expand power production from nuclear plants. These improvements will be accomplished within the economic limitations imposed by the local, both spatial and temporal, competitive cost of power. There is no reason to expect, so far as I can see, that improvements in breeding factor and specific power will do more than keep pace with expanding demands for raw materials to maintain the cost of feed and inventory at economic levels. It is unlikely that improvements in these performance characteristics, related to utilization of raw materials, will alleviate the problems connected with obtaining low plant cost per kilowatt of generating capacity and attaining low reprocessing cost per kilowatt-hour of energy produced.

I picture three broad phases in the growth of industrial utilization of nuclear power in this country. The first phase comprises plants that utilize natural or slightly enriched uranium as feed and inventory. The basic types of plants would include: (1) pressurized light water-cooled and moderated, (2) pressurized heavy water-cooled and moderated, (3) pressurized helium-cooled graphite moderated, (4) sodium-cooled graphite moderated. These would be what I call the poor nonbreeders. During this phase their performance characteristics would be gradually improved to the practical and economic limit of natural or low enrichment reactors. Perhaps some of the starters would drop out along the line.

The second phase would include good nonbreeders and poor breeders. Both would use highly enriched fissionable material as inventory, as well as fertile material. The early models of nonbreeders would require some fissionable material as feed, at most not more than a small amount, say 5 per cent, of total feed requirements. The later models would require only fertile material.

In this phase the availability of fissionable material at a cost which will not make inventory charges economically prohibitive will be a prerequisite to the practical feasibility of the plants. Thus, in addition to the requirement for a feed utilization at least close to 100 per cent, special emphasis will be placed on high specific powers, kilowatts per kilogram, in order to minimize fissionable material inventory requirements. The poor breeders of this phase are defined as not having a sufficiently large excess fissionable material production capacity to significantly contribute to the inventory requirements of new plants.

The third phase would see plants with large breeding factors and high specific powers combining to give relatively short inventory doubling times. In this phase nuclear power plants would begin to assume a substantial fraction of our annual requirements for expansion of energy production.

How Long Will It Take? The time when nuclear power can achieve this position in our industrial economy will depend upon a number of factors, most important being the economic incentives. Unless the long-term development of nuclear power is to be subsidized by public funds, the rate of improvement in plant performance will be determined by sound economic considerations.

Although the circumstances are certainly not analogous, some perspective may be gained by recalling the history of improvement in the efficiency of conventional thermal-electric plants. In 1888 it required thirty to forty pounds of coal to produce one kilowatt-hour. Today, less than one pound of coal produces the same energy, an improvement in efficiency of raw material utilization by a factor of thirty or forty over a period of sixty-five years.

The required range of improvement in nuclear plant efficiency is at least as great, if not greater. Arbitrarily assuming comparable technical difficulties, this comparison, together with the fact that nuclear plants must compete with an established and efficient process, leads one to expect a longer period for development.

An Immediate Program. In my opinion, both these long-range considerations and our short-term interests justify a reactor development program specifically oriented to attack the problems of economic nuclear power. Such a program should have the following broad areas of activity. First, projects for the design, construction, and operation of power-only plants designed on the basis of our present technology and investigating at least one, and preferably more than one, of the promising design approaches; second, a supporting development program directed at the problems of the next generation of plants; and third, a

program directed at the longer-range problems associated with economic plants having high breeding factor and high specific power. This program should include the construction of small experimental reactors.

The immediate objective of the program would be to remove the present uncertainties associated with the practical performance and economics of current technically feasible nuclear power plant designs. If one or more of these plants can be demonstrated as having practical value as economic producers of energy, we will then have substantially promoted our short-term interests and the first hurdle in establishing a long-range self-supporting program will have been cleared.

What is the AEC Doing? As you know, the Atomic Energy Commission is specifically authorized by its enabling act to develop nuclear power for industrial use. Last May the Commission issued a Statement of Policy with regard to a program for the development of nuclear power. Among other things, it stated:

(1). The development of nuclear power is an objective of national importance.

(2). The objective of the AEC policy is to "further the development of nuclear plants which are economically independent of government commitments to purchase weapons grade plutonium."

(3). The time has not yet arrived to turn responsibility over to private enterprise—it is still the responsibility of the AEC "to continue research and development in this field and to promote the construction of experimental reactors which appear to contribute substantially to the power reactor art and constitute useful contributions to the design of economic units."

Since that Policy Statement was issued the nature of the Commission's immediate program in the area of power development for civilian use has been more specifically indicated. From the published hearings of the House Subcommittee on Appropriations and from the language of the Appropriations Act as passed by Congress, one learns the following:

(1). Funds are provided for "research and development for any reactor which will advance technology toward both ship propulsion and the generation of industrial power and for design of such reactors." The funds available for this activity, about $4 million for FY 1954, were originally earmarked for the aircraft-carrier propulsion plant. When the requirement for this plant was cancelled by the Department of Defense, the funds were reallocated as described.

(2). In addition, the Commission has authority to spend up to $7 million of money appropriated for research and development for the beginning of construction of such dual-objective reactors. It is important to note that funds for construction are not appropriated but must be obtained from savings in research and development programs.

(3). No other funds are appropriated for the construction of pilot or experimental plants, or for the engineering development of advanced breeder designs.

The nature of the program was described by Gordon Dean at his last press conference as Chairman of the Commission as "a kind of double-purpose project as now conceived."

The appointment of Admiral Strauss to succeed Mr. Dean as Chairman of the Commission has introduced some new uncertainties into the program. Although Mr. Strauss, in his statement before the Joint Committee at its recent open hearings, confirmed his general accord with the Commission's earlier statement of power policy, at the same time he noted that he "was not prepared to rule out the possibility of plants which are designed to produce weapons-grade plutonium as a by-product of power."

Thus, on the basis of available information, we must conclude that the Commission's current reactor development program and its plans for the immediate future do not include projects directed specifically toward single-purpose nuclear power plants for civilian use.

What About a Private Enterprise Program? A number of industrial concerns have been looking at nuclear power to determine what they are prepared to undertake with their own funds. It is significant that no unqualified proposals for the construction of experimental or prototype power-only plants have resulted from these studies. Even assuming the enactment of favorable government policies covering ownership of plants, materials, and patents, this is not surprising in view of the uncertain performance of power-only plants, the risk of substantial sums of money, and the necessarily prudent financial policies of organizations responsible to large numbers of stockholders.

The recent open hearings of the Joint Committee on Atomic Energy on the subject of atomic power and private enterprise have clearly established a number of interesting items. First, there is a wide range of opinion among responsible executives of private enterprise, even among those associated with companies engaged in the same type of business. Some hold that if the government should relinquish its monopoly, then private enterprise would push ahead with characteristic vigor. Others contend that the government should retain its prime responsibility for the development of nuclear power, at least for the first generation of plants, and that even if the present legislative provisions and patent policies were revised that, speaking for their own companies, they would not consider risking their stockholders' money in nuclear power ventures. These conflicting points of view by equally responsible industrial executives indicate the presence of other factors and motivations which are not superficially apparent. In view of the conflicting statements, one must form one's own opinion as to the probable effect of legislative and policy changes on the extent of support of a power-only program by private enterprise. My conclusion is that no short-range construction program would evolve.

Not only is there disagreement as to the desirability of making drastic changes in legislation and policy at this time, but a strong opposition is building up to any changes. This opposition has developed in the Con-

gress and among certain public and private groups. These groups include labor organizations and publicly and cooperatively owned power systems. The opposition in most instances is directed against hasty and ill-considered action, and the timing of any action, rather than against the proposition that private enterprise should participate in the development of nuclear power. Many are of the opinion that there is no need for drastic legislative revisions at this time, that the AEC should and will support the necessary programs. In view of the abundant evidence to the effect that military interest is a prerequisite if a project hopes to obtain and retain financial support from public sources, I doubt that this approach is realistic.

I would not want to predict what actions, if any, will eventually be taken in the legislative field. However, I would venture to say that the formulation and enactment of specific revisions with regard to the major items of ownership of fissionable material, production plants, and patents which will be satisfactory to private enterprise and at the same time protect the public's interests will take a long time. At best, we cannot expect any firm commitments for power-only projects supported wholly by private risk capital until satisfactory legislative changes are consummated.

In concluding, I would like to specify a little more precisely the type of program called for in my title. First, it should have a single purpose. It should be directed solely toward the production of nuclear power for civilian uses—both short and long range. Second, the program and its objectives should be assured of continuing financial support, barring national emergencies or adverse technical developments. Third, it should require a minimum of associated administrative policy and legislative problems which would cause delays in schedule.

I would like to reemphasize what I said at the beginning. Whether or not this country establishes a strong single-purpose program to develop a practical nuclear power plant in the near future is not of vital importance to our general welfare or to our national security. So far as our own direct interests in nuclear power are concerned, it seems unlikely that a delay of ten years or more in starting a serious development program will have any serious effect.

However, the report of the President's Materials Policy Commission emphasized our dependence on other friendly nations for raw materials, uranium certainly not the least important of these, that add immeasurably to our own industrial and military strength. The technical and financial resources at our disposal would enable us, with relatively little extra effort, to develop a technology which shows promise of being of significant short-term importance to some of these countries. This is an opportunity to return "strength for strength." It is an opportunity that will not wait ten years, nor perhaps even half that length of time. It is rapidly slipping through our hands while other countries, presumably Russia included, are moving ahead with decisiveness.

The Immune-Adherence Phenomenon

An Immunologically Specific Reaction Between Microorganisms and Erythrocytes Leading to Enhanced Phagocytosis

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IN STUDIES designed to demonstrate phagocytosis of virulent *Treponema pallidum in vitro* (*1, 2*), observations on control preparations led to a recognition of an immunologically specific reaction between normal human erythrocytes and treponemes sensitized with antibody from syphilis serum. The reaction required a heat labile substance in normal serum, presumably complement (C′). Although not definitive, the experiments suggested that this reaction was an essential precursor to phagocytosis of the treponemes by human leucocytes.

The present experiments provide additional data on the reaction of *T. pallidum* with erythrocytes, and demonstrate that a similar reaction occurs with other microorganisms, e.g., *Diplococcus pneumoniae, Shigella paradysenteriae, Salmonella typhi, Micrococcus aureus,* and *Mycobacterium tuberculosis.* Further, it is shown that the union of sensitized organisms with erythrocytes, hereafter termed the immune-adherence phenomenon, leads to an enhancement of phagocytosis.

Experiments with *T. pallidum*

Requirement for Antibody (Table 1). Treponemes were isolated from testicular syphilomas of rabbits irradiated with 600 r prior to infection as previously

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described (*1–3*). Seven-tenths milliliter of a suspension[2] containing approximately 10^7 organisms/ml was mixed with 0.1 ml of: (*a*) ultrafiltrate of ox blood serum as a protein-free control; (*b*) normal rabbit serum; and (*c*) varying dilutions of syphilitic rabbit serum. After 30 min at 37° C, 0.2 ml of normal human blood was added to each mixture. After an additional 30 min the blood cells were removed by centrifugation at low speed (500 rpm, 5 min). The number of treponemes in the fluid phase was counted by darkfield microscopic examination of 0.01 ml of supernatant fluid placed under a 22-mm² coverslip at 675 × magnification.

TABLE 1

ESSENTIAL ROLE OF ANTIBODY IN REACTION OF *T. pallidum* WITH NORMAL HUMAN WHOLE BLOOD

Material added to treponemes prior to addition of blood	Initial serum dilution	Treponemes in fluid phase after incubation with whole blood for 30 min*
Serum ultrafiltrate	Undil.	92
Normal serum	Undil.	96
Syphilis serum	Undil.	0
Syphilis serum	1 : 5	4
Syphilis serum	1 : 25	34
Syphilis serum	1 : 125	86
Syphilis serum	1 : 625	86

* Number of treponemes per 10 fields in suspension not exposed to serum or blood cells, but brought to volume with saline only, 98.

While normal rabbit serum and human whole blood were inactive in causing disappearance of the treponemes from the fluid phase, syphilis serum was highly active in dilutions up to 1:25. The specificity of this reaction for antibody in syphilis serum was established by examination of 385 human sera (*4*). Reactivity of the sera in inducing clearing of the fluid phase corresponded with the clinical diagnosis of syphilis and with results of the treponemal immobilization test in all except five instances.

Necessity for C′ (Table 2). Mixtures containing 0.6 ml of treponemal suspension, 0.1 ml of syphilis serum, and 0.2 ml of washed human blood cells, were mixed with 0.1 ml of varying dilutions of fresh serum as a source of C′ from each of three species: human, guinea pig, and rabbit. After 30 min at 37° C, the mixtures were centrifuged and the treponemes in the fluid phase were counted by darkfield microscopy.

Greater than 90 per cent of the treponemes disappeared from the fluid phase of mixtures with undiluted C′ of the three species. No disappearance occurred in controls containing only heated serum. On the basis of the dilution required for disappearance of 50 per cent of the treponemes, human (1:34) and guinea pig (1:36) C′ were approximately equal in

[2] Relatively dilute suspensions of all microorganisms have been employed in this study in order to avoid agglutination. With organisms highly susceptible to agglutination, immune serum was used at a dilution exceeding that which caused agglutination.

TABLE 2

REACTIVITY OF THREE SPECIES* OF C′†

Reciprocal of C′ dilution‡	1	4	16	64	256	Heated serum only, undiluted
Human serum	2	32	80	146	235	215
Guinea pig serum	2	18	74	145	255	250
Rabbit serum	14	62	175	246	250	245

* The 3 samples of serum used as a source of C′ were assayed previously with nonsensitized treponemes and found to be free of specific treponemal antibody.

† Number of treponemes per 20 fields in fluid phase of mixtures containing sensitized treponemes, washed human blood cells, and dilutions of fresh serum (C′). Treponemes were sensitized 60 min at 37° C with syphilis serum, previously heat-inactivated to remove C′.

‡ Fresh serum diluted in heated (56°, 60 min) serum.

reactivity, whereas rabbit (1:7) C′ was weakly reactive. By contrast, the hemolytic titers of these same sera, measured by the technique of Mayer *et al.* (*5*), were as follows: human, 24; guinea pig, 195; and, rabbit, 10.

Later experiments with pneumococci and erythrocytes in which guinea pig serum was absorbed with a washed specific precipitate of a heterologous antigen-antibody system have indicated that the heat labile substance is C′.

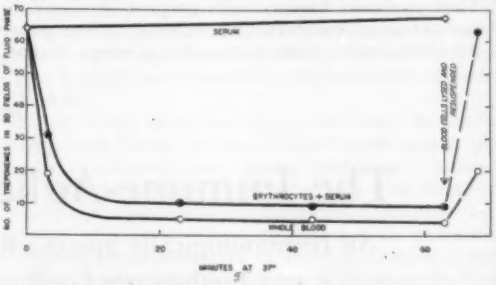

FIG. 1. The rate of clearing of the fluid phase induced by whole blood and by erythrocytes and C′. Recovery of the treponemes from the centrifugate of mixtures containing erythrocytes and C′.

Role of Erythrocytes (Fig. 1). Four mixtures were prepared containing 8 volumes of sensitized treponemes with 2 volumes of: (*a*) fresh human serum (C′) only; (*b*) defibrinated human blood; (*c*) washed human erythrocytes and C′; and (*d*) washed human leucocytes and C′. Samples were removed and centrifuged immediately after mixing, and thereafter at intervals of 20 min for 60 min. The numbers of treponemes in the fluid phase were counted by darkfield microscopy. At the end of the experiment the sedimented blood cells were lysed by alternative freezing and thawing to decrease refractility of the erythrocytes, and then resuspended to the volume of the original reaction mixture. Samples were removed for counting of the treponemes by darkfield microscopy.

Clearing of the fluid phase occurred equally in the mixture containing whole blood and in the mixture

containing washed erythrocytes and C′. No decrease in the number of organisms occurred in mixtures with C′ only, or with leucocytes and C′.

The explanation for the reactivity of erythrocytes became apparent when the sedimented red cells were resuspended at the end of the experiment. Essentially all the treponemes, i.e., 62 of the original 64, could be recovered, and the vast majority of these were adherent to the surface of the erythrocytes. It was obvious that the union of the organism with the erythrocyte, which required antibody and C′, had caused the disappearance of the treponemes from the fluid phase.

However, in mixtures containing whole blood, only 20 per cent of the organisms were recovered upon resuspension of the lysed blood cells. It is suggested that the difference between recovery from mixtures with erythrocytes and recovery from mixtures with whole blood represents the number of organisms phagocytized by leucocytes in the latter.

In experiments not shown here, the specific role of the erythrocyte in this reaction was indicated in that no clearing of the fluid phase and no microscopic evidence of adherence of treponemes was noted when erythrocytes were replaced by human platelets,[3] by fine particles of charcoal or magnesium silicate, or by suspensions of *Candida albicans*. Furthermore, sensitized treponemes did not react with washed sheep erythrocytes, and were only slightly reactive with washed rabbit erythrocytes, when the assays were performed under the conditions outlined above.

Experiments with *D. pneumoniae*

Adherence to Erythrocytes (Table 3). Normal human blood was defibrinated by shaking with glass beads. Samples of erythrocytes and of leucocytes were prepared by the albumin flotation technique (7) and were restored to original concentration in fresh autologous serum. Heat-killed (56° C, 15 min) pneumococci, type 1, were washed in saline, and 0.5-ml samples were sensitized with 0.1 ml of rabbit pneumococcal antibody (1.6 μg antibody nitrogen) at a concentration slightly less than that which produced microscopic agglutination. Suspensions of sensitized organisms, as well as suspensions of nonsensitized controls, were mixed with the 0.1-ml samples of human blood cells as shown in the table and gently agitated at 37° C for 60 min. The blood cells were removed by low speed centrifugation and the numbers of organisms remaining in the fluid phase were determined by darkfield microscopy.

There were no decreases in mixtures without antibody. No decrease occurred in blood cell—free controls with antibody only or with antibody and C′. Approximately 98 per cent of the sensitized pneumococci were removed from the fluid phase by defibrinated whole blood. From classical concepts it might have been interpreted that this clearing of the fluid phase by whole blood was due to phagocytosis of the pneumococci by leucocytes. However, as in the experiments with *T. pallidum*, washed erythrocytes and C′ were quantitatively as reactive as whole blood in clearing the fluid phase.

[3] The lack of reactivity of platelets was confirmed in repeated assays, since it was in contrast to the results obtained by Rieckenberg with leptospira (6). The latter reaction, termed the *thrombocytobarin* phenomenon, consisted of the adhesion of platelets or of bacteria to leptospira in the presence of specific leptospiral antiserum.

TABLE 3

Reactivity of Blood Components in Clearing the Fluid Phase of Mixtures Containing Pneumococci and Antibody

Materials added to suspension of pneumococci	No. of pneumococci* in the fluid phase after 60 min at 37° C (per 10 fields)	
	Without antibody	With antibody
None	120	118
Serum only (C′)	Not measured	120
Whole Blood	108	2
Erythrocytes + C′	110	1
Leucocytes + C′	Not measured	140

* Chains of organisms were counted at 1 unit.

Despite the fact that phagocytosis was expected to occur, there was no decrease in the number of organisms in the fluid phase of the mixture containing leucocytes, antibody, and C′. It should be emphasized, however, that the experimental conditions were designed to minimize contact between organism and phagocyte, i.e., relatively dilute suspensions of both pneumococci and leucocytes were employed. The rationale for the experimental design will be discussed in detail in future publications but, in brief, the proportion of reagents was adjusted to simulate what is believed to be the natural events wherein an immune, or partially immune, host is exposed frequently to small numbers of pathogenic microorganisms that gain access to the body tissues or the blood stream. The conditions wherein large numbers of bacteria are in contact with large numbers of leucocytes, e.g., in abscesses, may involve different mechanisms of phagocytosis.

Upon darkfield examination of the resuspended centrifugate of the erythrocyte mixture, or directly of samples of this mixture without centrifugation, the majority of the pneumococci were found to be adherent to the surface of the erythrocytes, as in Fig. 2. No significant lysis of erythrocytes was noted. Agglu-

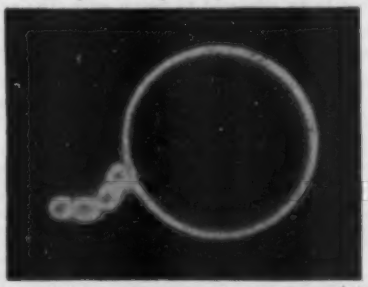

Fig. 2. Darkfield photomicrograph of *D. pneumoniae*, type 1, adherent to the surface of a normal human erythrocyte.

tination of the erythrocytes was not seen, although on occasions more than one erythrocyte was adherent to the same chain of pneumococci.

Enhancement of Phagocytosis (Table 4). Since no clearing of the fluid phase occurred with leucocytes in the preceding experiment, the procedure was repeated with larger numbers of leucocytes and a longer reaction time. Washed pneumococci, rabbit pneumococcal antibody, washed human erythrocytes, human C′, and leucocytes from an artificially produced exudate in the peritoneum of guinea pigs were employed as listed in the table. The degree of phagocytosis was determined on stained preparations of samples removed directly from the reaction mixture prior to centrifugation and recorded as the percentage of phagocytic cells containing pneumococci.[4] Since varying degrees of degeneration of pneumococci in phagocytes were noted in the 60- and 120-min samples, only the 30-min determination is recorded. Samples were removed at each time interval and were centrifuged for measurements of the number of organisms in the fluid phase.

There was no decrease in the number of pneumococci in the fluid phase of the antibody-free control at any of the times of sampling, and in 30 min only 4 per cent of the phagocytes contained organisms. Without erythrocytes, but with antibody and C′, there was a 20 per cent decrease in fluid phase count after 120 min, and 18 per cent of the leucocytes contained pneumococci. In the complete reaction mixture with antibody, C′, leucocytes and erythrocytes, 95 per cent of the organisms were removed from the fluid phase, and 60 per cent of the leucocytes exhibited phagocytosis at 30 min.[5]

Since antibody and C′ are essential for the immune-adherence reaction of microorganisms with normal erythrocytes, this phenomenon is differentiated from the absorption of soluble antigens, viruses, etc., on normal erythrocytes, which is postulated to be immunologically nonspecific. The latter absorption reaction, which often leads directly or indirectly to agglutination of the red cells, is stated to occur without, and in fact may be inhibited by, antibody, and does not require C′.

In studies on the localization of bacteria injected into immune animals, Rich (*8*) described tissue specimens in which the organisms were agglutinated and appeared to be adherent to tissue cells. The relationship is not clear between the observation of Rich and the findings of the present study for two reasons.

[4] Measurements of the percentage of phagocytes containing pneumococci were employed since the number of organisms within the phagocytes varied only from 1 to 4 in the majority of experiments.

[5] On repeated occasions samples of mixtures, similar to the complete reaction mixture described here, have been examined directly by darkfield microscopy. Numerous examples have been observed wherein leucocytes phagocytized pneumococci which were adherent to erythrocytes. These direct observations have proved of great interest in that varied maneuvers of the leucocyte have been seen, all of which, however, terminate in removal of the pneumococci by the leucocyte from the erythrocyte surface, leaving the erythrocyte free. Phagocytosis of both erythrocyte and the adherent organism has not been observed.

TABLE 4

ENHANCEMENT OF PHAGOCYTOSIS OF SENSITIZED PNEUMOCOCCI IN THE PRESENCE OF NORMAL HUMAN ERYTHROCYTES

Reaction mixtures*	No. of pneumococci in 10 fields of the fluid phase after			Percentage of leucocytes containing phagocytized pneumococci at 30 min
	30 min	60 min	120 min	
Antibody-free (Pn, RBC, WBC, C′)	80	80	84	4
Erythrocyte-free (Pn, Ab, WBC, C′)	78	78	60	18
Complete (Pn, Ab, RBC, WBC, C′)	21	12	4	60

* Volumes of reagents in 10 ml: pneumococci (Pn), 5 ml; approx. final concentration, 75×10^4/ml. Antibody (Ab), 1 ml; containing 16 μg antibody nitrogen. Leucocytes (WBC), 2 ml; approx. final concentration, 75×10^4/ml. Erythrocytes (RBC), 0.25 ml of packed cells. Complement (C′), 1 ml of fresh undiluted serum. The mixtures were incubated in silicone-treated (*Dry Film*, General Electric Corp.) tubes in a constant-speed rotator at 16 rpm at 37° C.

First, on repeated occasions in the experiments described here, organisms were seen in stained preparations to be directly adjacent to the various cells employed. Since this was noted in mixtures both with and without specific antibody and/or C′, it was adjudged to be an artefact incurred during drying and staining the preparation. To avoid this difficulty, fluid preparations were examined by darkfield or phase microscopy for the immune-adherence phenomenon. Thus, drying, fixing, and staining were unnecessary. Second, the present experiments indicate that certain other cellular elements will not substitute for the erythrocyte in the immune-adherence reaction, and, further, that only certain species of erythrocytes were capable of reactivity.

Under the experimental conditions of the present study in which limited numbers of organisms and of phagocytic cells are employed, the immune-adherence phenomenon leads to an enhancement of phagocytosis, and thus, the normal erythrocyte may function as an opsonic agent. The mechanisms by which the adherent microorganisms become more susceptible to phagocytosis are not defined. These may be similar to enhancement of phagocytosis of organisms in the absence of antibody wherein the phagocyte can trap the bacterium against certain surfaces, as demonstrated by Wood and associates (*9*). On the other hand, it is possible that substances from the erythrocyte surface may coat the microorganism and render it more susceptible to phagocytosis.

Since phagocytosis may occur without erythrocytes, classical techniques whereby concentrated suspensions of bacteria are mixed with suspensions containing large numbers of leucocytes might well mask the opsonizing role of the erythrocyte. Other techniques employing whole blood as a source of leucocytes and

in which stained preparations are examined at the completion of the experiment for organisms within leucocytes fail to reveal the events preceding engulfment, i.e., the potential opsonizing role of the erythrocyte. The present observations suggest the necessity for control of the number and species of erythrocytes in quantitative measurements of phagocytosis *in vitro*. Moreover, if antibody and $\mathcal{C}'$ are present in the reaction mixture, it is obvious that phagocytosis alone is not measured by the technique of Maaløe (*10*), in which clearing of the supernate fluid from mixtures containing bacteria and whole blood is used as an end point. The present data demonstrate that in such measurements washed erythrocytes and C′ may be quantitatively as reactive as whole blood.

The observation that erythrocytes play a role in an immunologic reaction with organism, antibody, and C′ offers advantages to studies on the *in vivo* resistance of the host to infection, and also may lead to the development of clinical diagnostic procedures involving the use of preparations of erythrocytes and microorganisms for the detection of circulating antibody.

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News and Notes

Sixth International Congress for Microbiology

The Congress was held in Rome Sept. 6–12, in the halls of the Città Universitaria. Concurrently six symposia on topics of general interest in microbiology were held in the adjacent Istituto Superiore di Sanità. Under the presidency of V. Puntoni, the organizers of the Congress were host to some 2000 delegates from 60 nations; the actual number of registrants, including guests and students, was undoubtedly much higher. In recognition of the Congress, the Italian Government issued a postage stamp that appropriately bore the picture of Agostino Bassi who, in 1834, showed for the first time that a microorganism was the causative agent of a disease in an animal. The Congress medal, presented to all delegates, was a very handsome relief of Franciscus Redi, done in heavy white metal from the design by Mistruzzi.

An elaborate program of entertainment was arranged for the members of the Congress and included a party in the beautiful garden of the Istituto Superiore di Sanità, a reception by civic officials at the Campidoglio, a symphony concert, and an excursion to the excavations at Hadrian's villa and to Tivoli. It was obvious to all that the organizers of the Congress, and especially the general secretary, E. Biocca, and his staff had striven to make every arrangement for the details of the Congress. That they succeeded nobly, was generally agreed.

Over 1000 communications were presented in the 4½ days devoted to the work of the Congress. The papers, covering an extremely wide range of topics, were arranged in 32 sections and subsections. Competition for attendance among sections covering closely related fields was intense and was aggravated by the competition from the some 60 papers of general interest presented concurrently among the six symposia. Most of the sections and subsections were devoted to subjects that have come to comprise the traditional structure of an international congress of microbiology. Many of the sections were well organized and featured arrays of papers of considerable general interest. However, one or two of the sections reflected the inability, or unwillingness, of the organizers of the Congress to reject papers offered to them. It was, indeed, a travesty on the large amount of substantial work contributed to the Congress that much of the press coverage was devoted to a few lurid accounts that ought not to have appeared on the program. The press coverage, in general, concerned itself with the spectacular and with the outlandish; although only the former might be classed as news for the average reader, a substantial level of science reporting would seem to be incumbent upon the metropolitan daily press.

Among the several pounds of printed matter handed each of the delegates were the abstracts of papers to the Congress (over 1000 abstracts contained in 3 large volumes) and a volume of abstracts of the symposia papers. It is especially noteworthy that the full texts of papers presented at the symposia were available in print while the Congress was still in session. The director of the Istituto Superiore di Sanità, Domenico Marotta, and his staff deserve commendation for getting the 6 sizeable volumes into print with such speed. The relatively low prices of the symposia volumes and the general interest of many of the papers contained therein will undoubtedly assure a wide demand for these books. The subjects of the symposia were: Bacterial Cytology, Microbial Metabolism, Nutrition and Growth Factors, Growth Inhibition and Chemotherapy, Biology of Actinomycetales, and Interaction of Viruses and Cells. It is impossible to single out for comment individual contributions from the 65 papers presented at the symposia or from the 1000 papers

presented at the sections of the Congress. However, it might be noted that among the latter those in a special subsection on Toxoplasma (F. Bamatter, Geneva, president), at which 24 papers and a round-table conference were scheduled, appear to merit being printed together and in full. The same might be said for certain groups of papers presented in the very large sections on Immunology and Immunochemistry (O. G. Bier, São Paulo, and Michael Heidelberger, New York, presidents).

With the increasing size of the congresses, and the lavish scale of entertainment and accouterment that have become traditional, it has become more and more difficult for member countries of the International Association of Microbiologists to accept the responsibility for future congresses. The VIth Congress adjourned without a site for the next congress being determined. In view of the sectionalized tendencies that are becoming increasingly apparent in international congresses and in the large national meetings, the question might well be raised whether the pattern in international meetings exemplified by the Cold Spring Harbor Symposia is not one which will prove to be more informative and beneficial than meetings on so gigantic a scale as the Sixth International Congress for Microbiology. There is much to be said in favor of small international gatherings of 100–200 persons for the discussion of restricted areas—the work of the group can be reviewed in detail, its proceedings can be published in one or two volumes, and limitations on the site for the meeting would be few.

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Science News

Harlow Shapley of Harvard College Observatory has selected the following eleven top **astronomical highlights** of the past year:

1. A conference this past summer of photoelectric astronomers at the Lowell Observatory, meeting under the auspices of the National Science Foundation, during which definite progress was made in discussions of the advisability of establishing, in the near future, a cooperatively-operated research observatory, probably in the Southwest. It would give special reference to the immediate requirements of photoelectric programs and be available also for possible expansion for general astronomical research.

2. The starting of construction of the 3000-inch steerable radio telescope at Jodrell Bank near Manchester, England, where work will be continued on nearby meteors and remote radio stars. A. C. B. Lovell of the University of Manchester reports that the new instrument will be used in an attempt to penetrate the dust clouds found in the Milky Way's rift in order to discover what lies beyond.

3. The design and preliminary testing by André Lallemand and his associates of the Observatory of Paris, France, of a device for electric photography, which promises to speed up greatly the recording of faint stellar objects.

4. Attainment for the first time of stars of magnitude 23 on the photographic scale, by means of the 200-inch Hale reflecting telescope on Mt. Palomar. W. A. Baum of Mount Wilson and Palomar Observatories achieved this by employing new photon-counting devices in photoelectric photometers.

5. As an important step in the analysis of the structure of galaxies, the exploration by radio of the Magellanic Clouds by Frank Kerr and J. V. Hindman of the Radiophysics Laboratory, Sydney, Australia, using for the first time the rapidly developing tool of the 21-centimeter radiation emitted by neutral hydrogen atoms in interstellar clouds. They found that the volumes of the Magellanic Clouds are larger and their motions more turbulent than those recorded on photographic plates.

6. Further developments in the revision of the extra-galactic distance scale, first reported as a high-light last year. The new work includes contributions by Walter Baade and associates at Mt. Wilson and Palomar Observatories; Gerald E. Kron of Lick Observatory and S. C. B. Gascoigne of Australia's Commonwealth Observatory, while working in Australia; A. D. Thackeray of Radcliffe Observatory, Pretoria, South Africa; Harold Weaver of the University of California; and Virginia McK. Nail and Harlow Shapley of Harvard College Observatory, who find, from a study of the brightest stars in the Magellanic globular clusters, that the previous distances to galaxies beyond our own should be multiplied by 2.2.

7. The measurement photoelectrically and the analysis at the McDonald Observatory, Tex., by Gerard P. Kuiper, Daniel L. Harris, III, and I. I. Ahmad of Yerkes Observatory, of the light variations of ten asteroids. Their studies confirm the belief that most asteroids are irregular rotating fragments, with the amount of reflected light of the sun varying with the asteroid's rotation, but with no change in color.

8. Studies of the night sky by Franklin E. Roach of the Naval Ordnance Test Station, Inyokern, Calif., in which he demonstrated the connection of the corona and the zodiacal light.

9. Pioneer theoretical work, by G. C. McVittie of the University of Illinois, on the application of certain Einstein relativity equations to gas dynamics, with potential usefulness in the study of interstellar material and phenomena associated with novae.

10. The detection in the solar spectrum, by a group from the Naval Research Laboratory working at White Sands, N. Mex., of the ultraviolet Lyman alpha line of hydrogen having a wavelength of 1216 A. The research team's observation, made by using rocket-borne photon counters shot above the ozone blanket to a height of some 50 miles, has been confirmed by William A. Rense and associates at the University of Colorado, also through the use of high-altitude rockets.

11. The observation by K. E. Machin and F. G. Smith of the Cavendish Laboratory, Cambridge, England, of the occultation of the strong radio source in

the Crab Nebula by the outlying parts of the solar corona when the nebula is still at a distance from the sun of as much as ten times the sun's apparent radius. This is far beyond the coronal streamers that can be recorded photographically.

On Oct. 28 a **ceremony in memory of Colin G. Fink,** who died in September, was held at Columbia University, in Havemeyer Hall. The focus of interest was the removal at that time of a pair of old door-knobs from a laboratory door and their installation in the Chandler Museum. These door-knobs, in use for nearly 30 years, are the first objects to have been chromium-plated by the process that Fink developed, the process that proved commercially successful and filled America with its present plenitude of shiny metal.

"Sensational investigations pose a serious threat to the scientific research which supports our national defense," the Council of the Federation of American Scientists, meeting in Chicago, declared. "Investigations which are characterized largely by sensational headlines and wholesale suspensions can, by crippling our defense research, actually result in a net gain for those who work against the interests of the United States." In expressing its concern, the Council called attention to important facts and issues that "have been largely overlooked so far in reports on the situation" at Fort Monmouth.

In support of its views, the Federation's Council pointed out that "no charges of actual espionage or subversive activity have been made against any of the approximately 30 scientists implicated. . . . Although the possible existence of espionage in any defense laboratory must always be conceded, it is difficult to see how the present suspensions . . . which have had such a serious effect on the operations and morale of the laboratories . . . are connected with the implications of espionage."

The scientists stressed that "the effect on our national security would be extremely serious if such investigative methods are allowed to spread to other areas of this country's scientific effort."

This statement has an obvious relation to the editorial comment printed after the summary of the report of the Committee on Battery Additives in SCIENCE, **118,** 684 (Dec. 4, 1953).

Scientists in the News

Louis H. Ahrens, Assistant Professor of Geochemistry in the Department of Geology and Geophysics, Massachusetts Institute of Technology, has resigned to accept a Readership in Mineralogy at Oxford University commencing in January, 1954. Prof. Ahrens is widely known for his spectrochemical research on geological age and will continue similar work in England.

Anderson Coelho de Andrade, a plant pathologist of the Instituto Biologico in São Paulo, Brazil, has joined the staff of The Connecticut Agricultural Experiment Station for a year. He is a specialist in the control of diseases of potatoes and tomatoes, particularly late blight.

John Alexander Ferguson, a specialist in the mineralogy of clays and formerly research officer with the Division of Building Research, Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia, has joined the staff of the Illinois Institute of Technology as geologist.

William F. Finzer, Director of the Guidance Institute of Berks County, Pa., has been named Director of the Pittsburgh Child Guidance Center in the University of Pittsburgh Medical Center, effective Dec. 1. He will also be an assistant professor in child development at the Pittsburgh School of Medicine.

Wiley D. Forbus, author of the 2-volume *Reaction to Injury,* has accepted a 6-month assignment in Formosa as a Mutual Security Agency consultant. Duke University School of Medicine has granted him a leave of absence.

The appointments of a superintendent for Stanford University Hospitals and of an acting assistant dean for Stanford Medical School have recently been announced. **Warner P. Geigenmuller,** Assistant Superintendent of the Hospitals, has been promoted to Superintendent. **George Bernard Robson,** San Francisco physician, has been named Acting Assistant Dean of the Medical School. He is an associate clinical professor of the school. Both posts were previously held by **William H. Northway,** who is also Professor and Head of the Division of Physical Medicine. Dr. Northway had asked to be relieved of the two administrative jobs in order to spend full time on medical and teaching duties.

The appointment of **Oliver Leroux** of Canada as the World Health Organization's South East Asia representative has been announced. Dr. Leroux's headquarters will be in New Delhi, India, where he is expected to act as the main link between the WHO regional office and the national health services of the participating countries. He will also be responsible for close cooperation with the health work administered by the Foreign Operations Administration (U.S.) and the Colombo Plan (British Commonwealth).

Lars Melander of the Nobel Institute, Stockholm, recently completed a month-long series of lectures on the general subject of "The Use of Nuclides in the Investigation of Organic Chemical Reaction Mechanisms." The lectures were presented at the University of Notre Dame under the auspices of the P. C. Reilly Chemistry Lecture Series.

George D. Stoddard, former president of the University of Illinois, has accepted the chairmanship of the Directing Committee of New York University's Self Study, now being conducted under a grant from the Carnegie Corporation. After February 14, 1954,

Dr. Stoddard will give full time to the study for a seven-month period. At present he is an educational consultant with Encyclopaedia Brittanica Films.

Theodore P. Wright, vice president for research at Cornell University, has been appointed chairman of the board of trustees of Associated Universities, Inc. The corporation is made up of a group of nine eastern universities which administer the Brookhaven National Laboratory.

Education

At the 64th annual meeting of the Association of American Medical Colleges, John M. Stalnaker of Chicago, an Association staff member, presented a paper entitled **"A Survey of Applicants."** His report indicated that students wanting to become physicians now have a better than 50-50 chance of being enrolled in the nation's medical schools. The survey showed that since the peak academic year, 1949–50, when 24,434 students applied for admission, the number of applicants has declined to a postwar low of 14,651 for the current year, 1953–54. The number of applicants has also dropped over the past four years from 88,244 in 1949 to 48,270 this fall. In 1949 each student applied to an average of 3.6 schools, while the current ratio is 3.29.

Duke University recently dedicated its **William B. Bell Research Building.** The late Mr. Bell was president of American Cyanamid Company and a trustee of the Duke Endowment, which helped finance the first unit of the building with a contribution of $190,000. The initial wing of the H-shaped $750,000 structure was begun in 1945 and the final section completed in 1952. The second addition to the original building was made in 1948 at a cost of $180,000. The financing was from the Duke Hospital and Medical School building fund. This wing houses the high-altitude chamber and several areas for experimental studies in surgery and medicine. A final $370,000 section was added in 1950, financed largely by the cancer and heart divisions of the U.S. Public Health Service. This third wing is used primarily for heart and cancer studies. All departments of Duke Medical School are carrying out research in their fields with space in the Research Building.

Stanford University has anounced the construction of a new $200,000 microwave laboratory. Work on the 15,000-square-foot building, which will be located next door to the present laboratory, will begin at once if weather permits. It is hoped that the structure will be ready for occupancy by next spring. The new laboratory will house approximately 75 staff members.

The Department of Biological Sciences, **University of Delaware,** announces a program of graduate study leading to the Ph.D. degree in biological sciences. General areas of graduate instruction and research in the department are: bacteriology; botany, including plant physiology; marine biology, including ichthyology and estuarine studies; general and cellular physiology; and zoology, including invertebrate zoology, embryology, and genetics. Inquiry concerning details of the program should be directed to Dr. James C. Kakavas, Chairman, Department of Biological Sciences, University of Delaware, Newark, Del.

The Division of Graduate and Postgraduate Medical Education, **University of Utah College of Medicine,** supported in part by a grant from the W. K. Kellogg Foundation, has utilized a new approach to give physicians an opportunity to participate in clinics and rounds. In cooperation with KDYL-TV, Salt Lake City, a series of **Postgraduate Television Clinics** is being presented weekly. These clinics are televised from the amphitheater of the Salt Lake General Hospital between 7:00 and 8:00 A.M., two hours before the regular broadcast day begins. Announcement of the time of broadcast was made only to physicians, but it is expected that a certain proportion of the lay population will tune in accidentally. Audience participation in this program is encouraged, and unlisted telephone service directly to the broadcast amphitheater is provided so that the doctors may ask questions during the program. Only the physicians in the area will be given the phone number for this type of participation.

These clinics represent the initial use of open circuit television for postgraduate medical education. Evaluation of Postgraduate Television Clinics is being carried out and will be published after completion of the present series.

Grants, Fellowships, and Awards

Eric Hodgins, author and member of the board of editors of *Fortune,* and Nathan S. Haseltine, science editor of *The Washington Post,* have won the **AAAS-George Westinghouse Science Writing Awards for 1953.** The $1000 awards will be presented Dec. 29 at a special luncheon in the Hotel Statler, Boston, during the annual meeting of the AAAS. Mr. Hodgins, who is the author of the novel, *Mr. Blanding Builds His Dream-House,* is being honored for his paper entitled "Power from the Sun," which appeared in the September issue of *Fortune.* Mr. Haseltine's prize-winning series of three articles on prisoner medical volunteers was published September 6, 7, and 8 in *The Washington Post.*

In his thought-provoking work, Mr. Hodgins states that "the best scientific [belief] . . . is that in the ultra-long run, solar energy will beat out atomic energy as the prime mover of the future world."

Mr. Haseltine's newspaper series revealed for the first time how convicts volunteered their bodies to medical science, first as a willing contribution to the war effort and later to enable continuation of studies which have "paid off handsomely in reducing human misery and saving American lives."

The judges voted honorable mention to two free-lance magazine writers, Albert Q. Maisel of New York City, and Norman John Berrill of McGill University.

Mr. Maisel's article, "They Fight for the Health of Kids They'll Never See," was published in the March issue of *Parents' Magazine*. Mr. Berrill's paper, "The Virgin Egg," appeared in the September issue of the *Atlantic Monthly*.

Entries were judged on the basis of their initiative, originality, scientific accuracy, clarity of interpretation, and their value in promoting a better understanding of science by the layman. The works entered in the competition were identified by number only; therefore, the judges could not know names, locations, or affiliations of the authors until after winners had been named.

In fulfilling their assignment, the judges felt impelled to draw up the following additional citation:

In the Science Writing Awards for 1953, the judges have, as in the past, endeavored to honor individuals for excellence in science writing. One of the entries before the judges was the result of the coordinated effort of many individuals and therefore not eligible for an award or honorable mention. The judges were unanimous, however, in regarding this entry as a distinguished example of science journalism, worthy of special recognition. Hence, a citation is awarded to *Life*'s Science Department and Mr. Lincoln Barnett for the series, "The World We Live In."

The American Heart Association has awarded the following research grants-in-aid for 1953–54:

University of California. D. M. Greenberg, Medical School. Tracer studies of certain components of proteins in relation to the development of high blood pressure and hardening of the arteries, $5250.

University of California. D. W. Peterson, College of Agriculture. Dietary factors influencing tissue levels of cholesterol, $5250.

University of Southern California. D. R. Drury, School of Medicine. The role of heredity and environment in the occurrence of high blood pressure, $4725.

Cedars of Lebanon Hospital. H. Goldblatt, Institute for Medical Research. Circulation in the minute terminal blood vessels in high blood pressure, produced experimentally in the dog, $3780.

University of California. I. S. Edelman, Medical School. Absorption and excretion of sodium, potassium, and water in the intestines, $7708.

Mount Zion Hospital. M. Friedman, Harold Brunn Institute. Cholesterol metabolism, $3150.

Stanford University. V. Richards, School of Medicine. Results of increased pressure in the blood vessels of the lungs on absorption of oxygen, $5250.

Mount Zion Hospital. R. H. Rosenman, Harold Brunn Institute. The role of potassium in maintaining blood pressure and in regulating the calibre of blood vessels in persons with normal or with high blood pressure, $3150.

Yale University. A. V. N. Goodyer, School of Medicine. The effects of alterations in the circulation on electrolytes and their excretion from the kidneys, $6048.

University of Colorado. J. K. Aikawa, School of Medicine. The development of immunity, especially in relation to rheumatic fever, $4252.

Georgetown University. E. D. Freis. School of Medicine. The work of the heart and its output, based on the use of a mechanical heart pump, $5250.

Emory University. E. B. Ferris and A. A. Brust, School of Medicine. The effect of restricting sodium on the circulatory system, $5250.

Medical College of Georgia. R. P. Ahlquist. The effects of certain adrenal-affecting drugs on the heart and blood vessels in experimental high blood pressure, $4462.

Medical College of Georgia. W. F. Hamilton and R. P. Ahlquist. Training program for research workers in the cardiovascular field, $8400.

La Rabida Jackson Park Sanitarium. E. P. Benditt. The nature of a substance derived from male sex glands and its effect on the permeability of blood vessels, $5376.

Northwestern University. G. R. Graham, Medical School. The flow of blood through the coronary arteries, $4200.

University of Chicago. R. J. Jones, School of Medicine. Study of a substance in the brain which lowers the amount of serum cholesterol, $5250.

Michael Reese Hospital. J. Stamler. Factors which regulate the work of the kidneys and the control of the body salts in experimental congestion of the blood vessels, $4200.

University of Illinois. G. E. Wakerlin, College of Medicine. Certain types of experimental high blood pressure, $5250.

Indiana University. J. D. Ebert, School of Medicine. Study of actin and myosin, $9607.

State University of Iowa. J. W. Culbertson, College of Medicine. The effects of surgical and medicinal treatment on the circulation to the liver and kidneys in certain diseases of the heart and blood vessels, $3150.

State University of Iowa. S. M. Horvath, College of Medicine. Results of sudden blocking of the aorta and vena cava, $5250.

University of Maryland. F. H. J. Figge, School of Medicine. Factors which cause overweight, and its effect on hardening of the arteries and other diseases of heart and blood vessels, $5680.

Johns Hopkins University. W. H. Gantt, School of Medicine. The mode of production of rapid heart action by nervous influences, $5250.

Johns Hopkins Hospital. W. R. Milnor. Results of shortcuts in the blood vessels on the volume of circulating blood, $5499.

Harvard Medical School. D. G. Cogan, Howe Laboratory of Ophthalmology. Studies of the cornea of the eye to determine the changes which result from aging, and specifically the relation of fat deposits in the cornea to fatty degeneration in the blood vessels, $4725.

Harvard Medical School. O. Krayer. A study of compounds of protoverine and germine and their action on the heart and blood vessels, $7875.

Harvard Medical School. S. M. Kupchan. A study of the veratrum alkaloids, which are able to lower blood pressure, $4181.

Massachusetts General Hospital. A. Leaf. Regulation of the fluid content of the body in health and disease, $4961.

Peter Bent Brigham Hospital. J. P. Merrill. Relation of kidney failure to various types of heart and blood vessel disease, $5250.

Harvard Medical School. M. J. Schlesigner. Coronary artery disease, $4200.

New England Center Hospital. M. Stefanini. Relation of the hormones to blood-clotting; possible agents to dissolve clots within blood vessels, $5250.

Harvard Medical School. G. W. Thorn. Relationship of the adrenal gland to high blood pressure, $4200.

Harvard Medical School. L. Tobian, Jr. A biochemical study of metabolic changes in the walls of normal blood vessels and those altered by high blood pressure, $4200.

Woods Hole Marine Biological Laboratory. A. Szent-Györgyi. Further studies on the molecular changes within muscle during contraction, $10,000.

Wayne University. C. Djerassi, College of Medicine. The isolation, chemical study, and effect on the body of a substance from *Pilocereus sargentianus* Orcutt, $4935.

University of Minnesota. R. A. Good, Medical School. The causes of and pathological changes which occur in rheumatic fever, studied by means of immunological, endocrinological, and biochemical methods, $6825.

University of Minnesota Heart Hospital. R. W. Von Korff. The chemistry of certain fundamental metabolic processes with probable bearing on the work of the heart and blood vessels, $5250.

Washington University. R. F. Furchgott, School of Medicine. Metabolic factors in the production of experimental heart failure, $5250.

Washington University. O. H. Lowry, School of Medicine. A specific protein in heart muscle, with the property of absorbing heart drugs, $2940.

Washington University. J. R. Smith, School of Medicine. The effects of certain allergic phenomena on the vascular system, and their relation to the occurrence of the collagen diseases, $3932.

University of Buffalo. D. G. Greene, School of Medicine. The influence of certain defects of the heart valves on the expulsion of blood, $4725.

Mary Imogene Bassett Hospital. J. Bordley III. Restricted expansion of the lung as a stimulus for breathing in normal persons and in those afflicted with diseases of the heart or lungs, $5250.

Mary Imogene Bassett Hospital. J. W. Ferrebee. The cor-

relation between certain types of cell damage and the changes in cell function, $7140.

Bellevue Hospital. A. P. Fishman, Cardio-Pulmonary Laboratory. The effects of the volume of circulating blood on heart failure; the sensitivity of the respiratory center of the brain to heart disease resulting from disease of the lungs, $5171.

State University of New York Medical Center. N. O. Fowler. The effect of lung expansion and respiration on the output of the right ventricle of the heart and on the resistance of the lungs to blood circulating through them, $3150.

Columbia University. G. H. Humphreys II, College of Physicians and Surgeons. Certain surgical problems of heart disease, $4200.

Montefiore Hospital. E. Hurwitt. Surgical treatment of mitral valve insufficiency due to rheumatic heart disease, $3150.

St. Luke's Hospital. J. H. Keating. Circulation in the kidney in relation to the excretion of albumin and electrolytes, $5250.

Montefiore Hospital. L. Leiter. Circulation in the leg muscles in heart disease, $5775.

New York University Bellevue Medical Center. J. J. Osborn. The use during surgery of refrigeration and a heart-lung machine for temporary interruption of circulation, $8268.

Cornell University. W. C. Robbins, Medical College. Experimental studies in rheumatic fever, $3543.

Council on Rheumatic Fever and Congenital Heart Disease. D. D. Rutstein. Cooperative study on the relative effectiveness of ACTH and cortisone in the treatment of rheumatic fever and the prevention of rheumatic heart disease, $3750.

Mount Sinai Hospital. J. H. Sirota. The role of the kidney in the development of heart failure, $3150.

Cornell University. R. C. Swan, Medical College. The regulation of salt balance in kidney malfunctioning, $5250.

New York University. M. B. Zucker, College of Dentistry. The influence of blood platelets on blood clotting, $4620.

State University Medical Center at Syracuse. A. E. Farah. The influence of agents that control metabolic functions on heart functioning, $4158.

State University Medical Center at Syracuse. J. S. Robb. The action of digitalis compounds on heart muscle, $5250.

University of North Carolina. C. B. Taylor, School of Medicine. The suitability of the *Macacus rhesus* monkey for experimental studies of artificial hardening of the arteries and cholesterol metabolism, $9450.

Duke University. J. V. Warren, School of Medicine. Results of altered blood pressure on the circulation through the lungs, $5250.

Wake Forest College. H. D. Green, Bowman Gray School of Medicine. The ability of the blood vessels to expand or to constrict according to the need for blood of organs which they supply, $4830.

University of Cincinnati. G. H. Acheson, College of Medicine. The fate of veratrine in the blood, and the possible role of the red blood cells therein, $3150.

Ohio State University. L. A. Sapirstein, College of Medicine. The composition of tissue fluid and the changes in it resulting from high blood pressure, $5250.

Antioch College. L. C. Clark, Fels Research Institute. Further studies on a heart-lung machine, $7728.

Oklahoma Medical Research Institute. C. D. Kochakian. The effects of the adrenal cortex on heart function, $5433.

Hahnemann Medical College and Hospital. C. P. Bailey. Changes in the work of the heart, blood vessels, and respiration following the surgical treatment of heart valve disease, $5250.

Temple University. D. A. Collins, School of Medicine. The preparation and study of liver angiotonase, and its role in the development of high blood pressure, $4725.

University of Pennsylvania. J. H. Comroe, Graduate School of Medicine. Measurement of the work of breathing and the efficiency of the lungs in persons suffering from shortness of breath, $6300.

University of Pennsylvania Hospital. F. C. Dohan. Changes in the urine by certain adrenal hormones, $7875.

University of Pennsylvania Hospital. J. R. Elkinton. The control by certain areas in the base of the brain over blood circulation and its importance in heart failure, $4058.

University of Pennsylvania. S. Gurin, School of Medicine. The formation of cholesterol and fats in the body and the effects of hormones on the process, $10,500.

University of Pittsburgh. T. S. Danowski, School of Medicine. The effects on the heart and circulation of using an artificial kidney (vivo-dialyzer) to remove salts from the blood, $6195.

University of Pittsburgh. R. E. Olson, School of Public Health. Effects upon the metabolism of heart muscle of heart failure resulting from heart valve disease, $8925.

Providence College. F. C. Hickey. The roles of certain metabolic products in various organs and tissues including the heart, $2003.

University of South Dakota. F. E. Kelsey, Medical School. The development of a highly purified preparation of digitalis for experimental use, $5985.

University of Tennessee. C. R. Houck, College of Medicine. The influence of various organs on high blood pressure produced experimentally in animals by removal of the kidneys, $7770.

University of Tennessee. R. C. Little, College of Medicine. Heart sounds, especially in relation to the filling of the heart with blood, $2992.

Vanderbilt University. F. Gollan, School of Medicine. The use of a mechanical heart-lung apparatus in experimental coronary occlusion to determine its value for patients with coronary heart attacks, $3780.

University of Texas. J. C. Vanatta, Southwestern Medical School. The use of ion exchange resins for experimental purposes, $4095.

University of Utah. S. C. Harvey, College of Medicine. The action of digitalis on the heart, $6300.

University of Utah. V. C. Kelley, College of Medicine. Adrenal hormones in relation to rheumatic fever and similar diseases, $5250.

University of Washington. R. F. Rushmer, School of Medicine. Factors which regulate the filling and emptying of the heart, $6615.

University of Wisconsin. D. R. Sanadi, Medical School. A study of some of the intermediate products of metabolism in heart muscle, $4200.

Institutio de Biologia y Medicina Experimental, Argentina. B. A. Houssay. Studies on experimental high blood pressure, $10,000.

McGill University. G. L. Duff, Faculty of Medicine. Appearance of cholesterol and other fatty substances during the early development of experimental hardening of the arteries, $6819.

Montreal General Hospital. J. H. Quastel, Research Institute. Fat metabolism in heart muscle, $5512.

The Middlesex Hospital, London. C. V. Nelson, Medical School. Electrical impulses in the heart, $1546.

American University of Beirut. G. Fawaz. The metabolism of the heart under the influence of certain metabolites, and the study of certain adrenal cortex hormones on the excretion of salt and water under experimental conditions, $4725.

Institutio Nacional de Cardiologia, Mexico City. J. B. Brumlik. Abnormal rhythms of the heart, especially fibrillation, involving interference with the normal conducting system of the heart, $5000.

The **Damon Runyon Memorial Fund** research grants for October are as follows:

Tulane University. A. Segaloff. The relationship of hormones in neoplasia, $10,000.

The Institute for Cancer Research. S. P. Reimann. Physiochemical study of cancer patients, $20,000.

Hahnemann Medical College. A. W. Wase. Investigation into the mechanisms of chemical carcinogenesis, $9700.

University of Minnesota. H. S. Diehl. Endocrine aspects of malignant growth, $10,000.

New York University, Washington Square College. H. C. Dalton, Dept. of Biology. Developmental control of melanophore differentiation, $3000.

Rutgers University. J. B. Allison and M. L. Crossley. Biochemical action of ethylenimines with tumor regression, $10,000.

Tuskegee Institute. J. H. M. Henderson, Carver Foundation. Auxin metabolism of crown gall and normal tissue in vitro, and an inhibitor of auxin production in tumor and normal tissue, $5000.

Fellowships

J. V. Landau, for training at New York University, $4800.

J. R. Vinas, to study at New England Center Hospital, $4000.

The following research programs are being supported by the **Muscular Dystrophy Associations of America, Inc.:**

New York Hospital. A. T. Milhorat, Cornell Medical College. Pathogenesis of progressive muscular dystrophy, $290,358.

New York Hospital. J. T. Ellis. Nature and pathogenesis of muscular degeneration in cortisone-treated rabbits, $8856.

University of Paris. G. Schapira. Biochemistry of muscle in progressive muscular dystrophy, $18,500.

Institute for Muscle Research, Woods Hole, Mass. A. Szent-Györgyi. Relation of electric charge-distribution in muscle fibers and in actomyosin to muscular contraction, $60,000.

New York Medical College. A. S. Abramson. Electromyographic studies on muscular dystrophy, $1750.

University of Washington. H. S. Bennett. Structure and cytochemistry of normal and degenerating muscle, $14,364.

University of Buffalo and Edw. J. Meyer Memorial Hospital. H. G. Dayman. Ventilatory force and quantitative measurement of diaphragmatic strength in health and in muscle disease, $3700.

Massachusetts General Hospital. J. Gergely. Paper-electrophoretic studies on muscle proteins, $4331.

Washington University. E. F. Gildea. Biochemical investigation of muscular dystrophy, $20,000.

University of Wisconsin. J. W. Harman. Relation of structure on the myofibrillar and mitochondrial systems of normal and dystrophic skeletal muscle, $18,387.

Alabama Polytechnic Institute. E. L. Hove. Relation of diet to the production and cure of muscular dystrophy in laboratory animals, $10,280.

University of Arkansas. W. K. Jordan. The role of nucleic acid in muscular dystrophy, $12,866.

University of Illinois. R. M. Kark. Carnitine metabolism in muscular dystrophy. $5000.

University of California. A. S. Rose. Muscle disorders studied by means of exchangeable radioactive potassium determination, $8164.

Bird S. Coler Hospital. J. S. Tobis. Proposed training program in physical medicine and rehabilitation of muscular dystrophy patients, $25,000.

University of Texas. R. J. Williams. Study of metabolic patterns of muscular dystrophy patients, $1700.

University of Utah. M. M. Wintrobe. Preparation of laboratory space for the study of hereditary and metabolic disorders, $8000.

University of Iowa. T. Winnick and H. M. Hines. Metabolic origin of carnosine and anserine and their possible physiological roles in muscle, $11,880.

Worcester Foundation for Experimental Biology. H. Rosenkrantz. Effect of steroid hormones on the incubation of tocopherol with skeletal muscle, $10,190.

University of Colorado. H. Herrmann. Chemical analysis of developing muscle tissue, $8343.

University of Colorado. A. R. Buchanan and V. Van Breemen. Electron microscopic studies of neuromuscular relationships under normal and pathological conditions, $7722.

Western Reserve University. P. J. Vignos, Jr. Muscle enzymes in progressive muscular dystrophy, $4860.

University of Pittsburgh. R. E. Olson. Synthesis and metabolism of glycocyamine, $9330.

Children's Hospital of Pittsburgh. T. S. Danowski. Muscular dystrophy survey studies, preliminary to trials of purified growth hormone, $8316.

Columbia University. T. Hayashi. Studies of surface-spread actomyosin fibers, $3240.

Columbia University. D. Nachmansohn. Interaction between ions and muscle proteins, $12,474.

University of Rochester. K. E. Mason. Structural and metabolic studies on degeneration and repair of skeletal muscle in experimental muscular dystrophy, $16,135.

National Institute of Neurological Diseases and Blindness. Potassium exchange, actomyosin tensile strength, metabolic changes, and endocrinological studies on a series of neuromuscular cases, $1714.

Johns Hopkins Hospital. K. L. Zierler. Relation of vitamin E to glycolysis in skeletal muscle, $8087.

Cornell University Medical College. Muscular Dystrophy Associations of America, Inc. Fellowship. M. L. Schoelly. Emotional factors in muscular diseases.

At the September meeting of the advisory committee of the **Research Corporation,** 60 grants totaling $150,000 were approved. The awards were made to the following 49 colleges and scientific institutions in this country, Canada, and Lebanon for support of research in the physical sciences, engineering, and mathematics:

Loyola University of Los Angeles. J. R. Schwartz. The nature of the bonding in aliphatic C-Nitroso compounds.

Howard College. John Xan. Completion of a small cyclotron.

University of Arkansas. E. S. Amis. A study of the dielectric constant and temperature dependences of the equivalent conductances of electrolytes at infinite dilutions.

University of California. C. D. Jeffries. Study of nuclear moments.

University of California. O. Struve. Study of B cephei stars and related objects.

University of California. R. K. Brinton and D. H. Volman. Photochemical and thermal studies of free radicals.

Colorado Agricultural and Mechanical College. M. L. Albertson. Sediment movement in closed conduits.

George Washington University. T. P. Perros. A kinetic study of the displacement reaction involving the fluoroplatinate ion.

Rollins College. H. A. Suter. Reactivity of selected derivatives of 8-quinolinol with metal ions.

Bradley University. A. H. Laurene. The solvent extraction of Co(II) as a means of separating cobalt from other metals.

DePaul University. F. S. Prout. The relationship of optically active quaternary carbon compounds.

Northwestern University. A. S. Hussey and R. H. Baker. The determination of configuration of the 10-methyl-2-decalols.

Northwestern University. R. L. Letsinger. An investigation of the chemistry of pyridazine.

Northwestern University. F. H. Seubold, Jr. Fundamentals of free radical processes.

Northwestern University. K. A. Strand. Research in double-star astronomy.

Southern Illinois University. J. W. Neckers. Periodates, composition and properties.

Rose Polytechnic Institute. S. G. Bankoff. Effect of fluid physical properties on heat transfer to boiling binary liquid mixtures.

State University of Iowa. R. Benesch. Polarographic investigations on the structure of proteins.

Kansas State Teachers College. E. W. Crandall. The reaction of aromatic hydrocarbons with carbon monoxide.

Kentucky Research Foundation. W. T. Smith, Jr. The preparation of an optically active benzo(c)cinnoline.

University of Louisville. R. H. Wiley. Infrared spectroscopic studies of 2-pyrones and 8-quinolinols.

Boston University. W. J. Gensler. Rearrangement of tetrahydrofurfuryl alcohol.

Clark University. G. Kegeles. Chromatographic separations and studies of protein cleavage products.

Harvard University. R. B. Woodward. Synthesis of cortisone.

Massachusetts Institute of Technology. N. A. Milas. Continuing work on synthesis of vitamin D_2 and vitamin A.

Kalamazoo College. R. O. Kerman. Light charged particle scattering cross-sections as a function of angle.

St. Louis University. H. B. Donahoe. Synthesis of drugs which paralyze striated muscle.

University of Kansas City. W. J. Rost. The synthesis of some dialkylaminoalkyl esters of some N-substituted carbamic acids.

Colgate University. A. S. Brown. The electro-chemical and surfactant behaviors of soluble penicillin-G salts.

New York University. B. R. Sundheim. The radial distribution function of an ionic fluid.

Rensselaer Polytechnic Institute. J. O. Hougen. Synthesis of control systems for physical and chemical processes.

Syracuse University. P. H. Barrett. Analysis of the decay of heavy mesons in nuclear emulsions.

University of North Dakota. R. E. Frank. The polarography of cyclooctatetraene (COT).

University of North Dakota. H. W. Hoyer. Foam fractionation of surface-active materials.

Bowling Green State University. A. J. Hammer. For anion absorption.

Ohio State University. J. G. Daunt. Nuclear orientation at low temperatures.

Oklahoma Agricultural and Mechanical College. O. H. Hamilton. An investigation into classes of continua having the fixed point property for continuous transformations.

Oklahoma Agricultural and Mechanical College. E. M. Hodnett. The isotope effect in the alkaline hydrolysis of ethyl methyl-t-benzoates.

Willamette University. R. L. Purbrick. An investigation of diatomic molecules formed from elements in the same column of the periodic system.

Duquesne University. T. L. Chu. Magnetic and spectroscopic studies of free radicals.

Duquesne University. K. C. Schreiber. A comparison of the reactivity of heterocyclic compounds.

Franklin and Marshall College. F. A. Snavely. Investiga-

tion of the relative strength of the O, S, and N bonds in the metal derivatives of *o,o*-disubstituted azo compounds.

Haverford College. O. T. Benfey. Studies in the identification of organic compounds.

Temple University. M. D. Stern. An equilibrium dialysis study of complex formation between proteolytic enzymes and enzyme-specific amino acids and polypeptides.

University of Pennsylvania. S. Shore. Model studies of the torsional rigidity of space frameworks.

University of Pittsburgh. B. E. Douglas. The racemization of optically active coordination compounds.

Carson-Newman College. C. T. Bahner. Synthesis of triazolopyrimidines and related compounds.

University of Tennessee. J. F. Eastham. Transformation of a resin acid into a steroid.

University of Tennessee. G. K. Schweitzer. The separation of carrier-free radionuclides by Szilard-Chalmers recoil from organometallic complexes.

The Rice Institute. M. G. Ettlinger. Chemistry of unsaturated three-membered rings.

Texas Southern University. R. F. Wilson. Spectrophotometric and polarographic study of certain rare earth and transitional elements that give color-producing reactions when treated with suitable reagents.

University of Texas. S. L. Brown. Study and applications of streaming potentials.

Utah State Agricultural College. M. C. Cannon. Chemistry of reactions at elevated temperatures.

University of Wisconsin. J. G. Winans. Retrograde motion of cathode spot of an arc.

University of Wyoming. J. E. Douglas. Low pressure thermal polymerization of ethylene.

Canadian Mathematical Congress. Associateships at summer research institute, $8600.

American University of Beirut. C. H. Issidorides. Reactions of trimethylene oxides with alcohols.

American University of Beirut. R. H. Linnell. Studies on N-heterocyclics.

University of Oregon. E. G. Ebbighausen. Anomolous effects in the behavior of spectroscopic binaries.

University of Oregon. G. Gorin. Metal-catalyzed oxidation of cysteine.

In the Laboratories

The Armour Laboratories have opened a new $12,000,000 manufacturing plant, known as the **Armour Pharmaceutical Center,** in Kankakee, Ill. It will produce Armour's line of special biological drugs, including ACTH and other pituitary hormones, trypsin and other enzymes, insulin, thyroid extracts, various liver extracts, and bovine albumin. Part of the facilities are devoted also to the production of blood fractions, i.e., gamma globulin and human serum albumin.

The **Bendix Aviation Corporation** has announced that it will concentrate an important part of its engineering work on oxygen systems for high-altitude aircraft at the Pioneer-Central Division in Davenport, Ia.

Hillary Robinette, Jr., has announced the formation of **Robinette Research Laboratories, Inc.,** with offices and laboratories at 16 E. Lancaster Ave., Ardmore, Pa. The new firm will provide research assistance for the textile, leather, paper, and chemical industries, as well as make technical and economic surveys of the chemical and chemical process industries.

The **Stanford Research Institute** has announced the acquisition of the facilities of the Microwave Engineering Co. of Los Angeles. With the transfer SRI has retained Microwave's staff of fifteen.

The **Wm. S. Merrell Company** of Cincinnati is expanding its Basic Medical Sciences unit by constructin a new Gerontological Laboratory. Ground will soon be broken for the new building, the fourth in Merrell's $2,000,000 research development program launched in 1951. Organic chemistry, autoclave, and microbiology laboratories have already been completed.

Meetings and Elections

The **American Foundation for Allergic Diseases** has been organized by the American Academy of Allergy and the American College of Allergists.

Officers of the new organization are: pres., Horace S. Baldwin, N.Y.; v. pres., J. Warrick Thomas, Richmond, Va.; sec., Bret Ratner, N.Y.; and treas., Theodore L. Squier, Milwaukee, Wis.

By terms of its charter, the foundation is to promote through public education an accurate understanding of the problems of allergic disease; to inform and educate the medical profession in the problems of allergy; to cooperate with medical institutions, hospitals, and other organizations in the development of facilities for the treatment and prevention of allergic diseases; and to finance facilities for research in the field of allergic diseases, including fellowships and residences. Provision is also made for the eventual establishment of local or regional branches of the central organization.

In stressing the need for the foundation, Dr. Baldwin pointed out that asthma alone is a leading factor in over 10,000 deaths in the United States each year, yet it is difficult for the average asthma patient of moderate means to get adequate treatment. Dr. Baldwin said:

> It is common experience that most general hospitals will not accept such patients because of the prolonged period of intensive medical and nursing care required. Hospitals treating acute diseases are reluctant to admit asthma patients because of the chronicity and the probable long-term stay, and the institutions for chronic care are poorly equipped to treat asthma. There is also a deficiency in the number of allergy clinics.
>
> Organized research on any sizable scale is likewise lacking. Some promising discoveries have been made recently in the mechanisms and therapy of allergic diseases, but these are often the accomplishment of individual workers and practitioners, operating in their spare time and with limited facilities
>
> Trained investigators, who can give full time are being attracted into other fields. Furthermore, the research that is being done under present conditions is frequently duplicated in several clinics and laboratories at the same time, resulting in inefficient efforts and wasted opportunities.
>
> The teaching of allergy in the medical schools is haphazard and inadequate. In some medical schools, allergy is neglected entirely. Due to the lack of hospital and clinic services, interns and residents have few opportunities for observation of patients. As a result there is a dearth of well trained young specialists.

Too late for either the Preconvention Issue of SCIENCE or the General Program-Directory is the announcement that the **Annual Illustrated Lecture of the National Geographic Society** at the Boston Meeting

of the AAAS will be "Into the Heart of Africa," narrated by Volkmar Wentzel of the Society's photographic staff, instead of the topic originally scheduled. The lecture promises to be outstanding; Society and Association members alike can expect this event to be as instructive and entertaining as have been all other annual special sessions of the National Geographic Society.

The first **Arab Science Congress**, meeting at Alexandria, Egypt, in September, took steps to organize Arab scientists and the scientific institutions of the Arab states into a permanent Arab Scientific Union. A committee will prepare the plans and secure the cooperation of the governments and scientists during the year ahead, then it expects to call a second congress in 1954 or 1955 for the organization of an Arab Scientific Union.

The publication of a general science journal in Arabic and the encouragement of the study of the history of Arab science are included in the objectives. The public lectures at the congress included a review of the great names of Arab science, such as Jabir-ibn-Haiyan, known in the western world as Geber, and Ibn Sina, known as Avicenna. Other lectures reviewed the historic contributions of Arabic scientists to mathematics, physics, and the nautical sciences.

The congress was called by the Cultural Administration of the Arab League and was opened by Pres. Mohammed Neguib of Egypt. A total of 321 scientists attended from eight Arab countries: Egypt, Iraq, Jordan, Koweit, Lebanon, Syria, Saudi Arabia, and Yemen. Sixty-five scientific papers were presented, and there was active discussion of the problems of the Arab countries with respect to scientific terminology, the translation into Arabic, publication of scientific papers and books, the training of science teachers, and the relation of science to the national economies.

The heads of the major delegations attending the congress were: Prof. Mustafa Nazif, Vice-Rector of the University of Ibrahim (Egypt); Dr. Sheeth Nu'mann, Director of the Research Council (Iraq); Mr. Mohammed Adib el Amry (Jordan); Melle Solwa Nassar (American University, Lebanon), and Prof. Toufik Mounadjed, Dean of the Faculty of Science of Damascus (Syria).

A feature of the congress was an exhibit of manuscripts and scientific publications concerning Egypt, installed at the Faculty of Commerce of the University of Alexandria. Pres. Neguib also formally opened the UNESCO science exhibition on "New Materials" at the Polytechnic Faculty. This exposition, containing more than 3000 items manufactured from modern plastics and from new metals and special alloys, was on exhibit during the entire congress and has now been moved to Cairo, where it will be on public view for about a month. The exhibit had previously been shown at Belgrade, Ljubljana, and Zagreb in Yugoslavia, and at Istabul in Turkey.

In September the **Lipotropic Research Fund** was organized by a group of industrial companies who are interested in stimulating clinical research with the lipotropic substances; in encouraging the publication of results of this research; and in disseminating to the medical profession and other interested scientific groups information relative to the value of the lipotropic substances. Grants from the Fund have been allotted to the following:

W. E. Cornatzer, Department of Biochemistry, University of North Dakota.

Thaddeus D. Labecki, Heart Disease Control Unit, Mississippi State Board of Health, Jackson.

Julius Pomeranze, Section of Nutrition, New York Medical College, New York City.

William B. Rawls, arthritis departments of St. Clare's and Poly-Clinic hospitals, New York City.

Additional information may be obtained from Louis Freedman, Chairman, Executive Committee, Lipotropic Research Fund, 52 E. 41 St., New York 17.

The 37th annual meeting of the **Mathematical Association of America** will be held at The Johns Hopkins University on Dec. 31. Of special interest will be the round table discussion on mathematics for social scientists by the faculty of the 1953 Summer Institute: W. G. Madow, University of Illinois; R. M. Thrall, University of Michigan; R. R. Bush, Harvard University; and Howard Raiffa, Columbia University. Another significant discussion will be a symposium, entitled "New College Mathematics," that will explore some aspects of the problems presented by efforts to introduce major reforms into the undergraduate program in mathematics. The participants are: G. B. Price, University of Kansas; C. V. Newsom, Associate Commissioner for Higher Education, State of New York; W. L. Duren, Jr., Tulane University; A. W. Tucker, Princeton University; and B. W. Jones, University of Colorado.

Two papers dealing with the transition from school to college will be presented, by H. W. Brinkmann of Swarthmore and E. G. Begle of Yale. Prof. Brinkmann is chairman of the Subcommittee on Mathematics of the School and College Study of Admission with Advanced Standing sponsored by 12 colleges and universities—Bowdoin, Brown, Carleton, Haverford, Kenyon, Massachusetts Institute of Technology, Middlebury, Oberlin, Swarthmore, Wabash, Wesleyan, and Williams. Prof. Begle was a member of the Mathematics Panel of the School and College Study of General Education sponsored by three schools—Andover, Exeter, and Lawrenceville; and three universities—Harvard, Princeton, and Yale. Both of these studies were aided by grants from the Fund for the Advancement of Education, established by the Ford Foundation. The retiring presidential address, "Of Course and Courses," will be delivered by Saunders MacLane, University of Chicago.

M. T. Carpenter, administrative director, Standard Oil Company of Indiana, has been elected president of the **Scientific Manpower Commission** for 1954, succeeding Howard A. Meyerhoff, the Commission's first president. Dr. Meyerhoff will continue to direct SMC activities, under the title of executive director. Mr.

Carpenter is also chairman of the American Chemical Society's Committee on Manpower and will retain this post in 1954.

Other new officers named in the election are: John S. Nicholas, of Yale University, succeeding E. G. Begle, as vice president; and Dael Wolfle, of the National Research Council Commission on Human Resources and Advanced Training, who will take over the responsibilities of secretary-treasurer from Milton O. Lee. Dr. Lee and B. R. Stanerson, of the American Chemical Society, will continue to serve as Executive Board members.

At the Commission's first annual meeting, five commissioners were re-elected for terms of three years starting Jan. 1, 1954: Howard A. Meyerhoff, on nomination of the American Geological Institute; George R. Harrison, American Institute of Physics; Leonard Carmichael, American Psychological Association; Milton O. Lee, Federation of American Societies for Experimental Biology; and Stewart S. Cairns, Policy Committee for Mathematics. Eleven other members of the Commission were not up for re-election this year.

The Commission voted unanimously for cooperation with the Engineering Manpower Commission of Engineers Joint Council (N.Y.) on all manpower matters of common interest. The EMC *Newsletter*, now circulated by the engineering organization, will become a joint publication of the two commissions with the first issue of 1954.

At the end of October, leading American and Canadian research scientists joined in a **symposium on protein metabolism** at the University of Toronto. Recent developments regarding pernicious anemia, infectious diseases, growth, and other problems related to metabolism in health and disease were discussed. The symposium was held under the joint auspices of the university's School of Graduate Studies and Department of Public Health Nutrition. The National Vitamin Foundation provided a grant to pay expenses for the meeting.

Jesse M. Shaver, Professor of Biology at George Peabody College, was honored at a dinner in Oak Ridge at the 63rd meeting of the **Tennessee Academy of Science** for his 25 years as editor of the Academy's journal. The speakers included Henry H. Hill, President of George Peabody, representing the staff of the College; John A. Behnke, Associate Administrative Secretary of AAAS, for the Association; Nathan Woodruff, Assistant Manager of Operations of the AEC, for Dr. Shaver's host of former students; and Aaron J. Sharp, Head of the Botany Department of the University of Tennessee and President of the Academy, for the Academy. Dr. Hill and Dr. Shaver were made honorary members of the Academy, and Dr. Shaver was presented with a gift from the Academy.

The two-day annual meeting, Nov. 27–28, featured the reading of papers in the various scientific fields and an impressive paper-reading session by members of the Junior Academy. These members enjoyed a tour of the Museum of Atomic Energy sponsored by the Oak Ridge Institute of Nuclear Studies. Honorary AAAS Membership Awards were made to four college and high school students; in addition, four Junior Academy members received Tennessee Academy Awards.

Officers of the Academy for the coming year are: pres., Myron S. McCay, University of Chattanooga; v. pres., Frederick T. Wolfe, Vanderbilt University; sec., Isabel H. Tipton, University of Tennessee; treas., James W. White, University of Tennessee; and editor, Jesse M. Shaver. The last three were re-elected.

Miscellaneous

Individuals and organizations with an interest in medical education may become members of the **Association of American Medical Colleges**, 185 N. Wabash Ave., Chicago 1, as a result of changes in the AAMC constitution made at the 64th annual meeting in October. The institutional membership had been limited to accredited medical schools. Membership is now open to medical school faculty members and others professionally linked to medical schools for a fee of $10 per year. Sustaining memberships, at $1000 a year, may be held by interested organizations.

The **Botanical Society of America** has established a new journal, to be called *Plant Science News*, that will begin publication on a quarterly basis in 1954. Harry J. Fuller of the University of Illinois is editor, and the following scientists are members of the editorial board: George S. Avery, Brooklyn Botanical Garden; Harlan P. Banks, Cornell University; Harriet B. Creighton, Wellesley College; Sydney S. Greenfield, Rutgers University; and Paul B. Sears, Yale University.

Functions of the new journal will be: (1) to publicize special fellowships, research fund sources, awards and prizes, etc.; and (2) to indicate to the members of the society, to the general public, to scientists in fields other than botany, to academic administrators, and to the national press services the implications of botanical sciences in contemporary life.

The World Health Organization has announced the publication of the first *World Directory of Medical Schools* which lists the more than 500 medical teaching institutions now open throughout the world, in 84 countries and territories, and gives essential data about each of these schools.

The information gathered by WHO for this bilingual, English and French publication includes the following: date of foundation, administration, academic year, conditions for admission, teaching staff, total enrollment, annual admissions, language of instruction, duration of studies, degrees obtainable, annual number of graduates, and tuition fees.

The International Association of Universities (and its executive organ, the International Universities Bureau) assisted the World Health Organization in compiling the directory, which is considered to meet a long-felt need and lay the foundation for more complete and more exact succeeding editions.

National Science Foundation Reports Estimates of Federal Obligations and Expenditures for Scientific Research and Development for Fiscal Year 1954

BOTH obligations and expenditures of Federal agencies for scientific research and development are expected to drop in fiscal year 1954 from the record totals established in previous years, according to the latest estimates compiled by the National Science Foundation.

decline in obligations for 1954 will presumably be reflected in a further decrease in expenditures in fiscal 1955.

These estimates, revised as of August 24, 1953, were based on appropriations approved by the 83d Congress, 1st Session. These 1954 estimates are still tentative, since several agencies plan further revisions in their programs.

The Department of Defense estimates constitute the largest portion of the totals for both obligations and expenditures. Present figures indicate that in fiscal year 1954 the Department may obligate $1556 million,

TABLE 1*

OBLIGATIONS AND EXPENDITURES OF FEDERAL AGENCIES FOR SCIENTIFIC RESEARCH AND DEVELOPMENT IN FISCAL YEARS 1952, 1953, AND 1954†

(Millions of dollars)

Agency	Obligations‡			Expenditures‡		
	1952	1953	1954 (Estimate)	1952	1953	1954 (Estimate)
Department of Defense	1,705	1,650	1,556	1,315	1,646	1,636
Atomic Energy Commission	229	247	239	250	260	266
National Advisory Committee for Aeronautics	82	79	73	67	79	88
Department of Agriculture	56	57	68	57	58	63
Department of Health, Education and Welfare	53	67	63	65	74	61
Department of the Interior	36	36	32	33	37	33
Department of Commerce	31	23	17	28	24	17
Other Agencies	25	28	26	24	26	24
Total, all agencies	2,217	2,187	2,074	1,839	2,205	2,187

* Source: National Science Foundation.
† Revised: August 24, 1953.
‡ Column items may not add to totals because of rounding.

Estimates of obligations for research and development are $2074 million for 1954 compared to $2187 million for 1953; expenditures are estimated at $2187 million in 1954 and $2205 million in 1953. Since the lag between obligations and expenditures has averaged about 9 months over the past several years, the

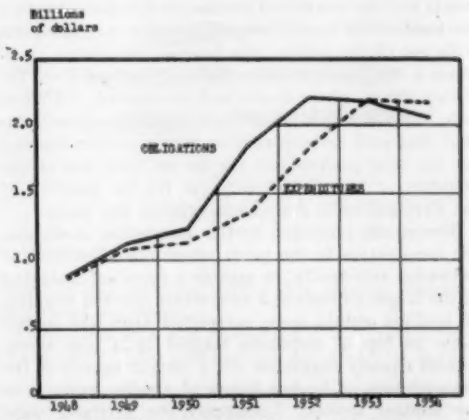

FIG. 1. Obligations and expenditures of federal agencies for research and development, fiscal years 1948–1954* (millions of dollars).

TABLE 2

OBLIGATIONS AND EXPENDITURES OF FEDERAL AGENCIES FOR RESEARCH AND DEVELOPMENT, FISCAL YEARS 1948–1954*

(Millions of dollars)

Fiscal years	Obligations	Expenditures
1948	877	865
1949	1,122	1,097
1950	1,244	1,143
1951	1,852	1,342
1952	2,217	1,839
1953†	2,187	2,205
1954 (Estimate)†	2,074	2,187

* Sources: Bureau of the Budget and National Science Foundation, and revised August 24, 1953.
† Revised August 24, 1953.

including a carry-over of $142 million from previous years.

The total obligations and expenditures for the major agencies for fiscal 1952, 1953, and 1954 are summarized in Table 1. The trend of research and development obligations and expenditures for the period 1948 through 1954 is shown in Fig. 1.

This information was compiled by the Foundation in connection with its continuing studies of the research and development activities of the Federal Government.

Technical Papers

A Strange Pleistocene Fossil Locality in Mexico

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In the course of further explorations in the Basin of Mexico, carried out in the summer of 1952, an unusual deposit of fossil bones was encountered that deserves special attention by those interested in the antiquity of man. The circumstances found in this excavation are so extraordinary that a brief account of them, if only to call attention to certain criteria which are apt to furnish indirect evidence for the occurrence of ancient prehistoric sites, is justified.

The locality was reported to staff members of the Dirección de Prehistoria, Instituto Nacionál de Antropología e Historia, Mexico City, by the owner of a pumice sand quarry. An excavation was carried out by Luis Aveleyra, M. Maldonado-Koerdell, and Arturo Romano, the same group of investigators who excavated mammoth and associated artifacts near Iztápan in the Tepexpan region. The site is situated a little over 5 miles west of the town of Tlalnepantla, on a dirt road leading to the pueblo of San Mateo. It is one of several pumice sand quarries scattered at the foot of a steep hill known locally as Huachichil.

The geologic situation shows dacite rock in faulted contact with pumice sand and agglomerate, against which rests a bone-bearing boulder deposit overlain by laminated brown clay and caliche. These strata can be identified with formations already known in the basin stratigraphy, such as the Tarrango pyroclastics, the Tacubaya, a fossil pedalfer type of soil, the older Becerra alluvium, and the Barrilaco caliche, a pedocal type of soil which caps the youngest Pleistocene sediments in the region. Their interpretation, as previously stated by the late Kirk Bryan and myself, is such as to suggest for the Tacubaya and older Becerra units ages that are roughly equivalent with the Wisconsin 1 and 2 stadials, whereas the caliche marks the close of the Pleistocene and the beginning of the geologic Recent. On this basis, the bone-bearing boulder deposit of the section would be of pre-Mankato age, representing the oldest known Pleistocene fossil bed in this region. This assumption is supported by the strong fossilization of the bones and more so by their association with sediments typical for the older unit of the Becerra formation.

The most puzzlesome array of features is presented by the bone-bearing boulder deposit; its origin cannot very well be explained by geologic agencies.

In the first place, the bones occur where the boulders are more numerous than at any other place on the hill slope. Approximately 70 boulders were found associated with the fossils in an exposure measuring 60 sq ft, whereas fewer than 10 boulders were seen at the same level in adjoining outcrops extending over 500 ft. The boulder layer is 2 ft thick and consists of dacite rocks of remarkably uniform size, each measuring 15 × 20 in. and having slightly worn edges. Practically fresh in appearance, they rest on a thin layer of sand, which marks a depositional contact with the weathered and ochre-stained pumice sand. A brown sandy clay provides a loose matrix in the boulder deposit containing local bone pockets. In excavating this layer two pairs of elephant tusks were found, each consisting of matching tusks of a mature and younger animal, perfectly preserved, and with boulders lying on top and under them. The undamaged condition of these tusks suggests that the boulders came to rest on top of unweathered ivory. Embedded between the boulders were found a perfect skull of giant camel, bones and teeth of *Equus crenidens*, edantates, bison (*Bison ? chaneyi*), carnivors, insectivors, birds, and rodents. The bone pockets were charged with rodent bones in unarticulated condition. The limb bones of other animals were broken up. This bone deposit was found covered by brown sandy clay, 6 ft thick, and laminated in the upper 2 ft.

A search on the hill slope yielded no other fossil locality and none was known to the quarry operators in that vicinity, so that one must assume a strictly localized association of bones with boulders. On first sight, such an association might well have resulted from an ancient waterhole, by the banks of a stream or in a lake lagoon, were it not for the fact that the boulders coincide singularly with the bone pocket and that they are of uniform size. In the absence of a stream deposit it is very unlikely that such a curious association could have originated from stream or lake waters. A shore feature, on the other hand, is suggested by the steeply curved contact between the sediments and the weathered pumice sand, especially since the level of the boulder deposit appears to correspond with one of the higher lake beaches designated as El Risco I. The boulders were obviously derived from the hilltop above, where dacite rock is exposed. An alternate mode of origin would be a landslide deposit, except that such an explanation would neither account for the bone pockets nor for the uniform size of the boulders, and most assuredly not for the position of the elephant tusks placed crosswise in two pairs.

The puzzle presented by this association challenges the imagination to the point where one is obliged, if somewhat reluctantly, to assume a purposeful slaying of the larger animals at a spot where selected boulders of medium weight were catapulted from the higher slope on top of elephants bogged on a lake shore. Almost equally suggestive for a human agency is the accumulation of broken bones of smaller animals in the boulder deposit. Unhappily, no artifacts were found in the excavation to verify the impression of an occupation site of prehistoric man. This locality may

retain its enigmatic character until similar conditions may possibly be encountered at the foot of a hill where a lakeshore environment favored better preservation of a prehistoric hunting skill which, to my knowledge, has not been recognized so far at a prehistoric site in North America.

Manuscript received October 2, 1952.

Iodinated Protein in Milk[1]

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Iodide has been demonstrated in the milk of women (*1, 2*) and of animals (*3*). We have reported that rats on a synthetic low iodine diet containing purified casein[3] do not develop goiter (*4*). This suggested the possibility of a substance in casein which prevented goiter. We found purified casein to contain 0.11 μg of iodide/g. This iodide was not removed by 6-hr soxhlet extraction with butanol or ethanol. The following experiment was performed to test for the production of protein bound iodine in milk.

Two lactating dogs were injected with 2.5 and 8 millicuries, respectively, of I^{131}. After 4 and 24 hr milk was collected. The milk was dialyzed against running water for 2–4 days and the dialyzate subjected to paper electrophoresis in a barbital buffer at pH 8.6 for 3 hr. Human serum and the dog serum were used as controls. An autoradiograph was prepared from the electrophoresis paper. The area containing radioactivity was then cut out and counted in an internal gas counter. Figure 1 shows the nondialyzable radioactivity of milk to move with a slow moving protein under these conditions.

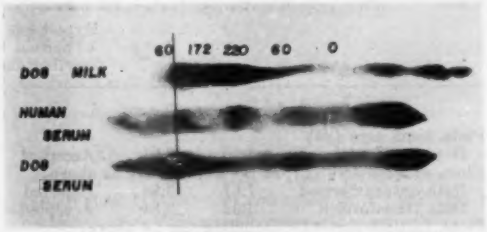

FIG. 1. Paper electrophoresis patterns. The nondialyzable I^{131} was found with the slow moving protein of the dog milk. Counts/minute of the various areas of the dog milk patterns are indicated above.

The dialyzed milk was hydrolyzed in 2 *N* NaOH for 12 hr at 100° C, then acidified and extracted with butyl alcohol. This extract was subjected to paper chromatography by the method of Gross *et al.* (*5*). Two radioactive substances were demonstrated using butyl alcohol, dioxane, and ammonia. Their Rf values were 0.25 and 0.35. Using butyl alcohol and formic acid, a radioactive compound with Rf = 0.58 was shown. The acid-butanol extract from less severe hydrolysis (0.5 *N* NaOH for 4 hr at 100° C) was chromatographed using *n*-butanol and acetic acid. One dominant radioactive compound was separated with Ff = 0.87.

These data are interpreted to indicate that milk contains an iodinated protein and purified casein possesses a thyroid-like property of goiter prevention.

Added in proof. Further experiments have demonstrated detectable quantities of I^{131} in all protein fractions of the electrophoretic separation of milk.

[1] This investigation was supported by grants-in-aid from the Atomic Energy Commission and U.S. Public Health Service.

[2] John and Mary R. Markle Foundation scholar in medical science.

[3] Nutritional Biochemicals Corporation.

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Manuscript received September 24, 1953.

Changes in Concentration of Hydrogen Ion During Precipitation Reactions Between Neutral Salt Solutions

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In discussing changes of hydrogen-ion concentration in chemical and biological systems all writers appear to assume without question that when two dilute neutral solutions of normal salts of strong or moderately strong acids and bases are mixed the resulting solution is also neutral, and that when two such solutions differ in hydrogen-ion concentration and from exact neutrality the hydrogen-ion concentration of the resulting solution will be between that of the two solutions. Neither appears to be generally true, however, when a precipitate is formed as a result of a chemical reaction between the two solutions.

As a good illustrative example, changes observed on mixing solutions of barium chloride and potassium sulfate may be cited. In the experiment in which 0.1 *M* barium chloride of pH 6.6 was slowly added to 0.1 *M* potassium sulfate of pH 6.4, the pH of the mixture or supernatant liquid as measured with a glass electrode rose steadily to a maximum of 9.5 just before the equivalence point and then dropped more rapidly through the equivalence point to about 7.2. When the solutions were mixed in the reverse order, the pH fell to a level of 5.7 before the equivalence point and rose to a maximum of 8.9 just after. The graphs of the changes in pH during the two titrations were

[1] National Science Foundation Predoctoral Fellow.

rough mirror images of each other. The extent and the pattern of the changes in hydrogen-ion concentration were found to vary considerably with the rate of mixing. Also, when the solutions contained a miscible organic solvent both the range of change in hydrogen-ion concentration and the sharpness of the change at the equivalence point were increased. For example, in an experiment in which 0.1 *M* barium chloride was added to a 50% ethanol solution of 0.1 *M* potassium sulfate the pH was 10.2 just before the equivalence point, and 6.5 just after.

We ascribe all such changes in hydrogen-ion concentration to the adsorption or desorption of hydrogen ions or hydroxide ions on the surface of the precipitates. The extent of the changes depends not only on the specific nature of the precipitate, but also on its state of subdivision, in other words its surface area. The different results observed with differences in rate of mixing and the greater changes caused by the presence of a miscible organic solvent may all be ascribed to differences in particle size and corresponding surface area.

This general effect is not only of theoretical interest but appears to be capable of practical application to analytical measurements. For example, by the use of a glass electrode as an indicator, we have been able to attain an accuracy of about 0.5% in the titration of sulfate with a standard barium solution.

Manuscript received September 30, 1953.

Biased Forest Stand Estimates Due to Sample Size[1]

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There has been a tendency toward the use of small samples in American forest sampling for ecological purposes. Relatively few investigations have used sample plots larger than the 100 sq m (approximately 1/40 acre) recommended by Cain (*1*), and an entire state survey (Wisconsin) has been based on sets of two-tree samples, the "random pairs" of Cottam and Curtis (*2*). Recent comparisons of the precision and efficiency of various forest sampling procedures in the Great Smoky Mountains (*3*) illustrate a generally unrecognized small-sample bias, which may lead to important errors in stand estimates.

Cumulative distributions of sample basal area values for tenth-acre, fortieth-acre, and random-pair samples taken at the same random points in a spruce-fir stand are plotted on probability paper, on which a normal distribution would lie along a straight line (Fig. 1). The mean of the random-pair samples is considerably higher than the median and is an unreasonably high stand estimate, but the estimate based on fortieth-acre plots, which has the same sort of bias in lesser degree,

[1] Contribution from the Botanical Laboratory, The University of Tennessee, N. Ser. 154.

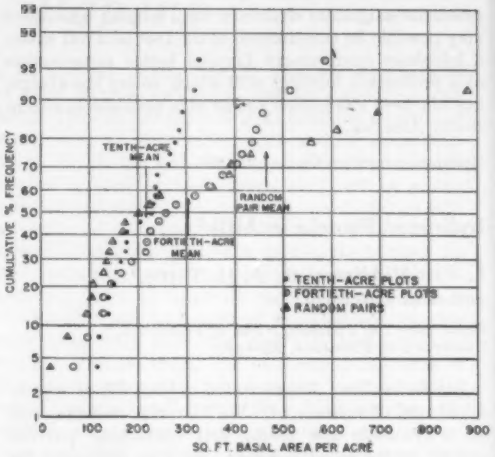

FIG. 1. Cumulative distributions of sample basal areas obtained from samples of different sizes, spruce-fir stand, Great Smoky Mountains. (The 24th point in each series is at infinity, and the 23rd point in the random-pair series lies off the graph, at 1680 sq ft.)

is near enough to a reasonable range to be accepted in the absence of comparative data or detailed analysis.

The form of several small-sample curves, including those in Fig. 1, suggested a logarithmic transformation, which brought the data into satisfactory agreement with the normal distribution, as is evident from the chi-square test (Table 1). This transformation made possible the application of conventional statistical procedures to the small-sample data, and resulted

TABLE 1

CHI-SQUARE TESTS OF GOODNESS OF FIT TO A NORMAL DISTRIBUTION

	χ^2	$\chi^2_{.05}$	Hypothesis of normal distribution
Spruce-fir forest type, all-aged			
Plots, tenth-acre (24)			
Data untransformed	1.00	3.84	Accepted
Plots, fortieth-acre (24, at the same points as above)			
Data untransformed	7.67	3.84	Rejected
Data transformed	1.33	3.84	Accepted
Plots, fortieth-acre (40, including the 24 above)			
Data untransformed	3.46	7.81	Accepted
Data transformed	2.79	7.81	Accepted
Random pairs (40, at the same points as above)			
Data untransformed	Very large	7.81	Rejected
Data transformed	3.57	7.81	Accepted
Deciduous forest type, buckeye-basswood-sugar maple, all-aged			
Plots, tenth-acre (25)			
Data untransformed	2.68	3.84	Accepted
Random pairs (39)			
Data untransformed	Very large	7.81	Rejected
Data transformed	.83	7.81	Accepted

TABLE 2

COMPARISON OF VARIOUS STAND ESTIMATES*

	Mean, untransformed data	Mean, transformed data	Median
Spruce-fir forest type			
Plots, tenth-acre	218.5*	—	227.4
Plots, fortieth-acre	293.7	247.8	243.2
Plotless samples	203.5	—	207.0
Random pairs	422.6	240.4	206.5
Deciduous forest type			
Plots, tenth-acre	171.4	—	162.5
Plotless samples	165.8	—	157.5
Random pairs	238.0	154.0	169.5

* Expressed in square feet basal area/acre.

in the markedly improved agreement of stand estimates illustrated in Table 2. Medians are included to show their close agreement with each other and with the more reliable of the means. They offer a promising evasion of the labor of transformation if the utmost statistical efficiency (*4*) is not required.

It is evident that conventional statistical treatment of small samples (one-fortieth acre or less) yields biased stand estimates, at least in the Appalachian vegetation. In the examples cited, this bias was reduced or eliminated by a logarithmic transformation, which validated the use of standard statistical procedures with random-pair and other small-sample data.

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On the Metabolism of Reichstein's Substance S

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It is an established fact that there must be an adrenal precursor to urinary androsterone and etiocholanolone because these compounds are excreted by castrates. For theoretical reasons Dobriner (*1*) has postulated that this precursor might be 11-desoxy-17-hydroxy corticosterone (Reichstein's substance S) because this substance is known to be present in the adrenals and has no oxygen function at C-11.

A generous gift of substance S from the Glidden Co. has enabled us to perform some metabolic experiments in humans. Previously Conn (*2*) has administered 400 mg of substance S to human subjects and achieved a great increase in urinary 17-ketosteroids, but he gives no information about the nature of these steroids. With the aid of a somewhat modified chromatographic separation technique according to Zygmuntowicz (*3*), we have registered the urinary excretion pattern of 17-KS before and after substance S was given to 4 patients and have analyzed the different fractions by infrared spectrography. First we gave 200 mg of substance S per os as the free alcohol but could not find any change in either the total amount of 17-KS or their relative amounts. In two cases, however, when we administered 300 mg of substance S as the monoacetate by the same route, we noticed in one case a small and in the other one a large increase in the 17-KS excretion. By infrared spectrography of the fractions in the 17-KS microchromatogram (Fig. 1) we made the following interesting observations. The tremendous increase in the fractions 18–30 is largely due to etiocholan-3α-ol-17-one. Androsterone is present but in a very small amount compared to the etiocholanolone. It is not possible to say with certainty whether there is an increase in androsterone excretion or not. The total increase in 17-KS excretion above the mean value before the administration of substance S was 60 mg, which is 27% of what could be formed stoichiometrically from the given amount of substance S-acetate.

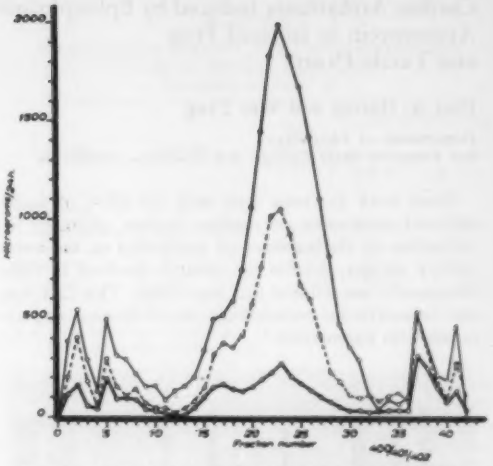

FIG. 1. Case P. T. ♀ Age: 50. Normal. Treated with 300 mg substance S-acetate per os. Heavy solid line: Before treatment (17-KS 4.4 mg/24 hr). Dash line: 1 day after treatment (17-KS 12.2 mg/24 hr). Light solid line: 2 days after treatment (17-KS 22.6 mg/24 hr).

It is of course too early to draw any conclusions concerning the significance of these experiments, but they suggest that substance S might be the precursor of at least some of the etiocholanolone which has its source in the adrenals. Research is being continued.

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Cardiac Arrhythmia Induced by Epinephrine-Aureomycin in Isolated Frog and Turtle Hearts

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Much work has been done with the effect of many different substances on cardiac rhythm, although information on the influence of antibiotics on the heart is very meager, despite the hazards involved in their therapeutic use without this knowledge. This fact was our incentive in undertaking the following experiments with aureomycin.[1]

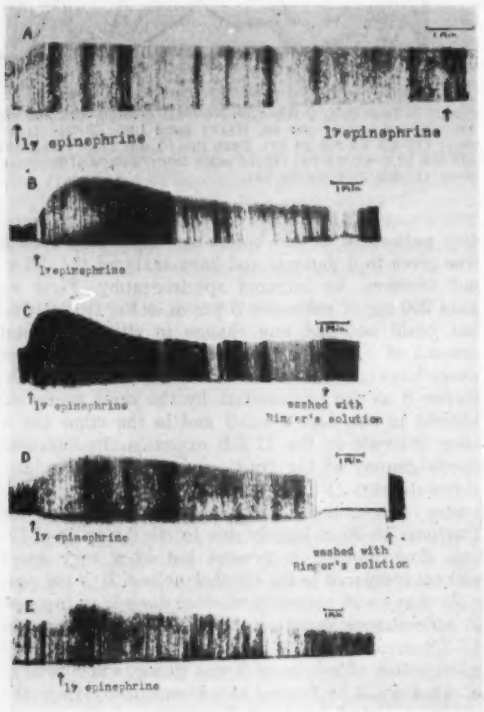

FIG. 1.

Isolated, perfused frog and turtle hearts were used. An animal was pithed, the heart was isolated, cannulated with a Straub cannula and perfused with Ringer's solution. The isolate included usually both vagi for stimulation. A Harvard type inductorium and a Harvard type spring kymograph were used. The emf in the primary circuit was 3 v with a distance of 5 cm between primary coil and secondary coil. A normal tracing was taken following perfusion of the isolate with epinephrine in Ringer's solution, or following epinephrine in Ringer's solution subsequent to perfusion with aureomycin in this same vehicle.

It was found that neither the frog, nor the turtle heart showed irregularities following administration of 1 γ/ml of epinephrine, although both normal chronotropic and inotropic effects were observed (Fig. 1 A). Irregularities began to occur upon addition of 1 γ/ml of epinephrine in a heart that had been treated previously with aureomycin-HCl (1×10^{-4} to 1×10^{-3} g/ml). However, the effect did not begin to appear until 20–80 min following treatment with aureomycin-HCl. They were negatively chronotropic and inotropic in nature and were relatively slight 20 min following treatment with aureomycin, but amounted to complete heart block 80 min following treatment with aureomycin-HCl (Fig. 1 B, C, and D). The degree of arrhythmia was proportional approximately to the length of time that the heart had been treated with aureomycin-HCl. The effects of the perfusates could be abolished following treatment of the isolate with KCl (0.276×10^{-3} to 0.328×10^{-3} g/ml), Fig. 1 E.

Epinephrine-aureomycin induced arrhythmia of the kind observed in isolated, perfused frog and turtle heart preparations shows that aureomycin treatment, prior to epinephrine treatment, first augments and then retards myocardial contractions in frog and turtle hearts. It is unlikely that a contaminant was responsible for the effect, since the aureomycin-HCl used in these experiments was a purified product that was intended to be employed for experimental purposes. Although we have no experimental evidence to account for the phenomenon, some work has been done which suggests that the energy-liberating mechanism that causes myocardial contraction may have been disrupted. Hotchkiss (*1*) suggested that gramicidin may have a bacteriostatic effect at its strength for therapeutic use by preventing normal energy exchange while stimulating a non-phosphorylative type of carbohydrate breakdown. He found that gramicidin increased the rate of respiration in *Staphylococcus aureus,* but inhibited the uptake of inorganic phosphate normally associated with respiration. Loomis (*2*) concluded that aureomycin depressed phosphorylation without inhibiting respiration, and that it resembled gramicidin in this behavior.

Enselberg, Simmons, and Mintz (*3*) found that potassium salts were capable of uniformly reducing or abolishing ventricular extrasystoles, and that bidirectional ventricular and auricular tachycardia could be successfully treated with them. Castledon (*4*) reported that administration of potassium salts resulted in disappearance of extrasystoles, and Sampson and Anderson (*5*) used potassium salts to check auricular and ventricular ectopic beats and tachycardias.

Isolated frog and turtle hearts, perfused with Ringer solutions containing aureomycin, and later perfused with solutions containing epinephrine, developed arrhythmias. When epinephrine was given 20 min after aureomycin, chronotropic and inotropic irregularities appeared about 10 min later, when the pres-

[1] Aureomycin-HCl supplied by the Lederle Laboratories Division of the American Cyanamid Company.

sor effect had almost disappeared. If the time interval was increased to 40 min, the irregularities became more pronounced. When the time interval was 80 min, complete heart block occurred, with failure of ventricular contraction. KCl administration just before perfusion of epinephrine abolished the arrhythmias.

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Complementary Enzyme Actions in the Clotting of Milk[1]

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According to Berridge (*1*) the clotting of milk by rennin or pepsin is a three-step reaction. The enzyme destabilizes the casein molecule, moderate thermal energy denatures the enzyme-modified molecule, and polyvalent cations crosslink the extended polypeptide chains into a coherent clot. The exact nature of the enzyme action is still obscure.

Below 14° C thermal energy is not sufficient to denature the rennin or pepsin destabilized casein molecule in any convenient time interval. However, if an appropriate protease is present, this denaturation may be brought about enzymatically. For the milk-clotting reaction, this enzymatic denaturing action complements the rennin-like destabilization action.

Many proteolytic enzymes probably can perform both types of enzymatic actions. Examples of this group are pineapple bromelain,[2] papain, and chymotrypsin. Other enzymes at the pH of the milk-clotting test can perform only one of these actions. Thus rennin and pepsin exhibit only the rennin-like destabilizing action at pH 5.3. Trypsin, on the other hand, exhibits principally a protein-splitting action (Table 1). Part of the milk-clotting action of the trypsin sample reported in Tables 1 and 2 may be attributable to chymotrypsin impurities.

If the low temperature milk-clotting ability of pineapple bromelain (Table 2) and papain (*2*) is attributable to two complementary enzyme changes, then it should be possible by combining a rennin-like enzyme with a protein-splitting enzyme to obtain a low-temperature milk-clotting combination. This hypothesis is amply borne out by the data in Table 2. A ratio of 0.44–0.48 milk-clotting units of rennin or pepsin to one protease unit of trypsin gave the best proportions for a low-temperature milk-clotting combination. If a correction is made for the milk-clotting activity of trypsin, the ratio of milk-clotting activity to protease activity is 0.52–0.56.

If similar calculations are made for pineapple bromelain, the ratio of milk-clotting units to protease units is 0.85, quite different from the figure for rennin-trypsin. Furthermore, the addition of either trypsin or rennin to pineapple bromelain increases the unit activity of pineapple bromelain. However, rennin has much more of an activating effect than trypsin.

At the temperature of standard milk-clotting tests, 37.5° C, the thermal denaturation step may proceed more readily than the protein-splitting step (*2*). Hence the standard milk-clotting test would measure principally the rennin-like action of the enzyme. Among different proteolytic enzymes no fixed relation-

TABLE 1

Milk-Clotting Activity and Casein-Solubilizing Acting of Several Proteolytic Enzymes at 37.5° C

Enzyme	Grade	Milk-clotting units*/g	Casein solubilizing units†/g	
			pH 5.3	pH 7.25
Pineapple bromelain	Experimental	4,670	5,500	14,000
Pepsin	N. F.	21,300	Neg.	Neg.
Rennin	N. F. V1	4,270	Neg.	Neg.
Trypsin	N. F.	400	5,000	17,500

* Modified (*3*) Balls and Hoover method (*3*); 5 ml of a 5% milk buffered to pH 5.3.
† Chow-Peticolas method (*4*).

TABLE 2

Effect of Combining Enzymes on the Time Necessary to Clot 5 ml of a 5% Skim Milk Solution at 4° C

Mg enzyme in 1 ml of added enzyme solution				Minutes for clotting
Bromelain	Trypsin	Rennin	Pepsin	
2.232	—	—	—	12.2
—	4.33	—	—	127.4
—	—	2.24	—	No clot
—	—	—	1.94	No clot
1.116	2.16	—	—	18.0
0.744	2.88	—	—	26.4
0.446	3.46	—	—	35.2
1.116	—	1.12	—	9.3
0.319	—	1.92	—	11.1
0.203	—	2.03	—	19.5
—	3.46	0.45	—	37.1
—	2.88	0.75	—	23.6
—	2.16	1.12	—	17.7
—	1.45	1.49	—	41.2
—	3.99	—	0.15	22.7
—	3.46	—	0.39	16.0
—	3.24	—	0.49	18.0
—	2.88	—	0.64	26.7
—	2.16	—	0.97	30.6

[1] Published with the approval of the Director of the Pineapple Research Institute of Hawaii as Technical Paper No. 214.

[2] For conformity with the rules for naming plant proteolytic enzymes suggested by Greenberg, Winnick, and Lineweaver (*Ann. Rev. Biochem.*, **14**, 31 [1945]) and for the orderly naming of the other enzymes found in the Bromeliaceae, a suggestion has been made to the A.C.S. Committee on Rules, Nomenclature, and Pronunciation that the name pineapple bromelain be substituted for bromelin.

ship would be expected between milk-clotting ability and protein-splitting ability even though the same site on one enzyme may be involved in both of these actions. However, once it has been established that an enzyme preparation consists of only one enzyme having the two actions mentioned and is not a mixture of two enzymes, then the milk-clotting test can be advantageously used with the appropriate correlation factor to assay an enzyme for protein-splitting activity.

The complete explanation of the effect of combinations of enzymes on the low-temperature clotting of milk may provide important clues to the structure of the casein molecule as well as to the mode of action of certain enzymes.

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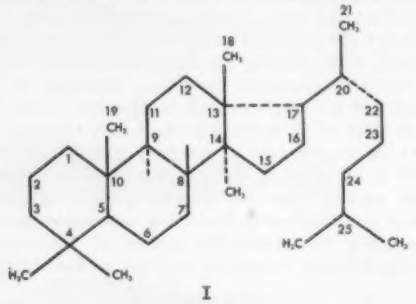
Comments and Communications

Suggested Nomenclatural Revision for "Triterpenoid" Steroids

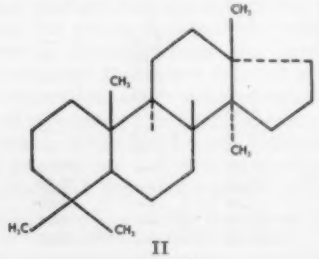
Recent studies by Ruzicka (*1*) and Barton (*2*) have indicated that the lanostane nucleus may be represented by (I). Systematically (*3*) this may be designated as 4,4′, 14α-trimethylcholestane.



I

It has been noted that the English workers do not use the steroidal numbering system in publications relating to this series of compounds, preferring instead to apply triterpenoid ciphers. This has tended to create confusion where none need exist, as the lanostane series is undoubtedly steroidal in all major respects and should be treated as such.

As an example of the dichotomy which is being practiced, Barton has recently proposed that the name "lanane" (II) be applied to the nucleus arising from lanostane by degradation. There is no particular objection to this new trivial name but the fact that it has been numbered as a terpene seems highly objectionable indeed, since it cannot be construed as anything but 4,4′, 14α-trimethylandrostane and should be numbered as such.



II

Since other nuclei (e.g., euphane) have been shown to be steroidal in nature, it is considered to be particularly important at this time to agree on a consistent nomenclature for the "triterpenoid" steroids. The usages of the Ciba Conference (*3*), though not completely satisfactory, are recommended.

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The Need for a Comprehensive Medical Audio-Visual Aid Center

The demand for teaching materials of all types is felt in centers of medical activity. Medical schools and institutions receive repeated requests for specimens, models, drawings, photos, exhibits, and various audio-visual aids. One physician asked for a model of coarctation of the aorta to illustrate a lecture before his local medical society. Another did not know where he could obtain anatomic drawings of the components of the mediastinum. A medical student requested a series of x-rays to portray the evolution of lung cancer. An intern wanted to look through a bronchoscope. A resident physician was interested in hearing pericardial friction rubs on a phonograpnic record. A teacher was setting up an exhibit on electrocardiography and desired electrocardiograms illustrating the common abnormalities. An anatomist sought a three-dimensional model of the renal glomerulus. A history teacher wished to display models of the blood pressure machines in all stages of its development. An inventor

desiring to improve the visual field of the gastroscope wanted models of gastroscopes from its inception to the present. Television studios needed many kinds of medical aids to illustrate their programs.

Appreciating the need, a group of medical people under the leadership of David J. Davis, Tom Jones, Thomas G. Hull, A. J. Carlson, Morris Fishbein, Haven Emerson, Burrell Rawlston, Chevalier Jackson, Hobart Reimann, and Raymond Allen organized a movement in 1950 to create interest in setting up a Medical Audio-Visual Center to serve the needs of the country. It proposed to extend the splendid work of the museum of the Armed Forces Institute of Pathology and make materials and exhibits available by loan for the purpose of study, teaching, and research. These materials include graphs, charts, EKG's, electroencephalograms, kinematograms, slides (both gross and microscopic), bacteriologic cultures, anatomic and pathological specimens, x-ray films, drawings, maps, photos, autographs, coins, transparencies, models in every medium, dioramas, panoramas, statuary, stamps, instruments (both surgical and medical), drugs, and relics.

The best of the exhibits presented at medical meetings would be preserved and whenever possible loaned, instead of being dismantled and discarded, as happens today. Much of the material is at hand, but the administrative machinery to put them to use is lacking.

A noble encyclopedic project like this, though of breath-taking scope, can be attained with the unselfish cooperation of medical organizations. The success of the Midwest Inter-Library Center in Chicago, which receives literature from, and loans to, twelve different universities which support it, is an example of cooperative achievement.

Such an institution proposes, in addition, to secure, preserve, and exhibit historical items, to perpetuate and make known the best of medical culture and ethics, and to deny these items from reaching the refuse heap, cellar, garret, or rotting in private collections, or from being pawned off by private collectors. Encouraged through the exchange of valuable paintings by art museums, it proposes to make available to medical schools and medical societies the precious manuscript of the Edwin Smith surgical papyrus now treasured by the Library of the New York Academy of Medicine, the original inhaler of William Morton encased in the ether dome at Massachusetts General Hospital, or the instruments that William Beaumont used on the gastric fistula of Alexis St. Martin, now on display at the University of Chicago Medical Library, and of the numerous memorabilia of which each center is proud. It is interested in establishing an agency to ferret out medical treasurers of all kinds. What has happened to the hearts from which Dr. James B. Herrick made his discovery of myocardial infarction in 1912? Where are the original rubber gloves invented by William S. Halsted in 1890?

The creation of a centralized audio-visual agency supported by the medical organizations of the country will have a profound effect upon the dissemination of medical knowledge, modern and historic, and will stimulate research teaching and medical culture. A rich field welcomes the industrious.

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Received June 30, 1953.

Pain—Controlled and Uncontrolled

"THINKING in pairs" is an old intellectual pastime. Dichotomies are set up between experimental methods (see Beecher, SCIENCE, 116, 157 [1952] versus Hardy, Wolff and Goodell, *J. Clin. Invest.*, 27, 380 [1948]) and read into results by the observers themselves. Objections against dichotomies create new ones, or simply substitute terms, e.g., *physiological* for *experimental* ([Ravich, SCIENCE, 118, 144 [1953]). All these cleavages cut across each other and in the end the pattern becomes impossible to disentangle. Dichotomies serve a certain purpose within a limited context but befog the minds of those who inflate them into becoming all-embracing issues.

Pain produced in the laboratory has some, but not all, aspects in common with pain produced by disease. It has some common aspects in animals and in man. In some other, but not in all, respects these various pains obviously differ, as does to a certain extent each moment of pain from the next in each suffering organism. All pain has physiological aspects, as well as such aspects as are anatomical, pathological, and zoological: you rarely find but what you look for. Pain is a biological phenomenon, but even the historian, the sociologist, anthropologist, logician, poet, or others may have something useful to say about it. An interesting and valid dichotomy could, for instance, be made between "scientific" and "lay" pain, or between "potential pain" which may be beneficial and "actual pain" which is not.

The Hardy-Wolff-Goodell team are criticized by Beecher (SCIENCE, 116, 157 [1952]) for studying contrived pain. Beecher points to the difference between this healthy pain and sick pain, between the emotional setting of the weary, suffering patient and the keen, comfortable subject in the laboratory. The Cornell team (SCIENCE, 117, 164 [1953]) grants the point but says rightly that it is not fundamental. Beecher says that it is. However, he adheres to the sensation-reaction dichotomy of the Cornell team. He even uses it as an argument against the validity of contrived pain research. Ravich, finally, distinguishes the "sensorial sensations" of contrived or physiological pain from, should we say, the "senseless sensations" of pathological pain.

It seems that not the artificiality of contrived pain is so much to be deplored as the artificiality of dichotomizing. While there is some difference between the suffering of ordinary mortals and the measured introspections (guessing at the stimulus rather than the sensation) by Hardy, Wolff, and Goodell and their trainees, a rigid dichotomy between sensation and reaction is at least as artificial as that between contrived

and uncontrived pain. The dolorimetrist cannot distinguish between stimulation and injury; all he does is register degrees.

Splitting the pain experience into "specific" components has not had a convincing demonstration. It is, moreover, doubtful whether on biological grounds the separation of perception, or sensation, from response is desirable. It probably was unhelpful of Hardy, Wolff, and Goodell to pit subjective perception as a constant against objective reaction as a variable: to warm up the old epistemological issue between feeling and observation, not to solve but to confuse it even more. Attacked on theoretical grounds, the dolorimetrists concede only that resynthesis may be "difficult," but maintain in favor of their theory that "the practical importance to the physician in controlling the various aspects of the pain experience is unquestioned." Nevertheless, one cannot help asking the practitioner what he has learned from the dolorimeter toward a more enlightened use or understanding of analgesics, narcotics, sedatives, and placebos.

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Estimation of Gene Frequencies from MNS Data

THE increasing use of blood group data in anthropology is shown by many recent publications (*1–4*). Next to the Rh system of genes, the MNS system is probably the most useful. In order to make use of all the information contained in each set of data, it is desirable to estimate the gene frequencies by an efficient method. A simple method of doing this for MNS data does not seem to have been published.

Maximum likelihood estimates of the gene frequencies are easily obtained as follows. Start with "consistent" estimates of the frequencies of the genes M and N. For a first shot the estimates $m_s = \sqrt{M}$ and $n_s = \sqrt{N}$ may be used, but formulas due to Mourant, which are shortly to be published (*4*), are better.

The total m frequency, which includes the frequency m_s (the frequency of the gene Ms) and m_g (the frequency of the gene MS) can be found by the usual gene-counting method as $m = M + MS + MN/2 + MNS/2$. Similarly $n = N + NS + MN/2 + MNS/2$. Consequently our estimates of the frequencies of MS and NS are $m_g = m - m_s$ and $n_g = n - n_s$.

Using these frequencies, calculate the expected frequencies of the six phenotypes:

$$M = m_s^2$$
$$MS = m_g^2 + 2m_s m_g$$
$$MN = 2m_s n_s$$
$$MNS = 2(m_s n_g + m_g n_s + m_g n_g)$$
$$N = n_s^2$$
$$NS = n_g^2 + 2n_s n_g.$$

Then calculate the two measures of the degree to which the provisional gene frequencies depart from the maximum likelihood values, from the equations:

$$\partial L/\partial m_s = (2M + MN)/m_s - 2MSm_s/(m_g^2 + 2m_s m_g) - MNSn_s/(m_s n_g + m_g n_s + m_g n_g)$$
$$\partial L/\partial n_s = (2N + MN)/n_s - 2NSn_s/(n_g^2 + 2n_s n_g) - MNSm_s/(m_s n_g + m_g n_s + m_g n_g),$$

where m_s, m_g, n_s, and n_g are the provisional gene frequencies, and M, MS, etc., are the observed numbers of individuals in the respective classes.

Then calculate three quantities

$$I_m = 4G[1 + (M)/(MS) + (N)/(MN) + (N)/(MNS)]$$
$$I_n = 4G[1 + (N)/(NS) + (M)/(MN) + (M)/(MNS)]$$
$$I_{mn} = 2G[1 + (MN)/(MNS)]$$

where (M), (MS), etc., represent the expected values as calculated above and G is the total number of individuals tested.

$$\text{Let } V_m = I_n/(I_m I_n - I_{mn}^2)$$
$$V_n = I_m/(I_m I_n - I_{mn}^2)$$
$$W_{mn} = -I_{mn}/(I_m I_n - I_{mn}^2).$$
$$\text{Then } \delta m_s = \partial L/\partial m_s (V_m) + \partial L/\partial n_s (W_{mn})$$
$$\delta n_s = \partial L/\partial m_s (W_{mn}) + \partial L/\partial n_s (V_n)$$

and the adjusted estimates of the gene frequencies are

$$m'_s = m_s + \delta m_s \quad \text{and} \quad m'_g = m - m'_s$$
$$n'_s = n_s + \delta n_s \qquad n'_g = n - n'_s.$$

If the corrections δm_s and δn_s are large, the process can be repeated with the improved estimates, although in general this is not necessary, as one application of the process yields efficient estimates (*5, 6*).

A similar method can be applied to the case of nine phenotypes resulting when an anti-s serum is also used. Calculations for this and other cases, as well as formulas for the variances of the estimates obtained, will be presented elsewhere.

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Received August 24, 1953.

Erratum. In the abstract of the paper, "The Direct Observation of Hapten-Antibody Equilibria" presented before the National Academy of Sciences, which was published in the Nov. 13th issue of SCIENCE, p. 570, there is an error due to a miscalculation. A value of 5.5 kcal is given for the free energy of formation (per mole) of a hapten-antibody bond. This value should be 7.6 kcal.

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Department of Chemistry, Harvard University

Book Reviews

An Introduction to Anthropology. Ralph L. Beals and Harry Hoijer, with collab. of Virginia M. Roediger. New York: Macmillan, 1953. 658 pp. Illus. $6.00.

This book is a rare event in the publication of English-language general anthropology texts: not only is it the fruit of joint authorship of the most intensive kind but it is also profusely illustrated with line drawings that, in the authors' words, "set a new standard for the illustration of anthropological textbooks." The body of facts and theories in each of the divisions of anthropology has become so great that it is hazardous for one person to attempt writing about them all; yet anthropologists have made few attempts at joint authorship of introductory texts, although such are clearly needed. Beals and Hoijer have succeeded admirably, indeed uniquely, in their collaboration; the style is uniform, examples are eclectically chosen, and the special interests of neither are revealed in most of the chapters, the exceptions properly being instances in which the subject of a chapter coincides with the major interest of one of the authors, e.g., Hoijer and language, Beals and acculturation. Dr. Roediger, who did the illustrations, has great skill in suppressing extraneous detail and this, combined with her close collaboration with the authors, has resulted in a series of pointed and illuminating figures and maps.

About a third of the book is devoted to human paleontology and physical anthropology, the remainder to cultural anthropology. The former portion contains a strong emphasis on genetics, but the lack of extensive and detailed knowledge of gene geography for humans prevents the authors from presenting a racial classification in other than the conventional phenotype terms. A closer and more convincing connection could have been established between genetics, fossil man, and racial varieties by more explicit reference to genetic processes such as genetic drift and to ecological phenomena that bear on evolution, speciation, and race formation. It would help greatly in dispelling the tendency among students to think teleologically on these matters.

The majority of the chapters treating cultural anthropology follow a conventional arrangement: technology, subsistence techniques, economics, social and political organization, religion, language, the arts, and education. The authors have chosen to emphasize structural and functional approaches in dealing with these topics, rather than the historical, and in so doing reflect a major current in contemporary American anthropology. This emphasis is carried to the degree that prehistory gets very short shrift as a separate topic, although some measure of historical perspective is restored in the chapters on technology, clothing and ornament, etc., by anchoring them in the findings of prehistoric archaeology. The ethnographic examples are presented entirely in the present tense—a convention in anthropology that facilitates comparative studies but one that merits reconsideration if it is to be used in a textbook. Students can be convinced of the utility of this practice for certain studies but rightly question its employment when referring to the buffalo-hunting Crow Indians.

It is a handsome and meaty book, adaptable to several teaching methods. Each chapter is subdivided into captioned sections, and these captions appear in the table of contents. The index is thorough and workable.

DAVID B. STOUT
Department of Sociology and Anthropology
State University of Iowa

The Chemistry of Synthetic Dyes, Vols. I and II. K. Venkataraman. New York: Academic Press, 1952. 1442 pp. Illus. $29.00 for set of 2 vols.

This two-volume work on synthetic dyes presents a very thorough survey of all the recognized dyes in the classical accepted order which starts with nitroso and terminates with cyanuric and miscellaneous types. Each class of dye is thoroughly discussed with respect to methods of synthesis, application, and reactions. In addition, considerable space is given in the earlier and later parts of these volumes to general discussions on the raw materials and intermediates required, color measurement and description, methods of dye application, analysis of dyestuffs, action of light on dyes and fibers, and the chemical character of substantive dyes.

The text is especially well documented with literature references which are well up to date, and in many cases the discussion shows a critical evaluation of current literature with extraction of ideas and conclusions which had escaped the technical writers of the paper. Although these volumes do not provide laboratory directions for synthesis or application, the applied as well as theoretical worker will find them to be of great assistance in all problems involving the reaction or properties of synthetic dyestuffs.

WALLACE R. BRODE
National Bureau of Standards
Washington, D. C.

X-Ray Crystallographic Technology. André Guinier; trans. by T. L. Tippell; Kathleen Lonsdale, Ed. London: Hilger and Watts, 1952. (U.S. distrib.: Jarrell-Ash, Boston.) 330 pp. Illus. + plates. $9.50.

The original book (Dunod, Paris, [1945]) was called *Radiocristallographie,*[1] a title obviously hard to beat. The English edition includes a foreword by Kathleen Lonsdale, who explains the raison d'être for the translation. The book was so excellent but so poorly put out that she felt her own copy would be frequently consulted and soon fall to pieces. Everyone will agree that the gem was worth a better setting.

[1] Reviewed for the *American Journal of Science* in 1946.

The book is geared to the solution of industrial problems other than crystal structure determinations. After introductory parts on x-rays, crystallography, and diffraction (88 pp.) come the experimental methods (86 pp.) and their application to the study of crystal shape and orientation (27 pp.), identification and strain problems (22 pp.), solid solutions (6 pp.), crystal imperfections (19 pp.), gases, liquids, and amorphous solids (10 pp.), and particle size (11 pp.). Small-angle scattering, Guinier's special field, is treated in the latter chapter. One appendix (19 pp.) devoted to the "know-why" gathers calculations and proofs skipped in the text. Nine appendices (33 pp.) take care of the "know how." With tables of data, references to charts and nets, and tables of interplanar distances, they make the book a self-sufficient working manual.

The translator is clearly no crystallographer. He does not know that Guinier's monocrystal is our single crystal, speaks of "reflections with respect to a plane," says "elementary cell" instead of "primitive cell," calls any row that passes through the origin an "axis," ignores the fact that the crystallographer who first defined the Miller indices was Whewell and not Miller, has trouble telling strain from stress, etc. Otherwise the style is good. Some changes can be noted: lengths are in A instead of kX, several references have been added, and an index is appended. The plates are excellent, their reproduction perfect. The bookmaking is up to the best British standards. Should such improvements induce us to scrap the old battered copy in Guinier's lucid French?

J. D. H. DONNAY
Departments of Geology and Chemistry
The Johns Hopkins University

Electrochemical Data. B. E. Conway. Amsterdam–Houston: Elsevier, 1952. 374 pp. $8.75.

This volume is a logical presentation of fundamental data normally used by practicing electrochemists. For the most part, the author has excluded all process data of an empirical nature, but he has endeavored to cover as completely as possible the fundamental information one would expect in such a book.

The author should be congratulated on the fine presentation of data collected from many different sources. Great care is used to list all original references and wherever possible precisions of the values are indicated. For example, in the table of "Standard Electrode Potentials of the Elements," these potentials are divided into three categories: those whose value is known within a millivolt, a centivolt, and values which are to be considered provisional in nature.

As would be expected with a first edition, there are some minor points that need clarification. The use of symbol *"G"* is somewhat ambiguous since he defines it as "free heat content" and uses it as "free energy." Further, it would be helpful if he specifically stated nomenclature with respect to sign of the electrode potential. In general, however, the author has performed an admirable service in presenting the data in a concise, practical fashion.

HENRY B. LINFORD
Department of Chemical Engineering
Columbia University

Scientific Book Register

An Introduction to Functional Histology. Geoffrey H. Bourne. Boston: Little, Brown, 1953. 198 pp. Illus. $5.00.

Methods of Mathematical Physics, Vol. I. Trans. from 2nd German ed. R. Courant and D. Hilbert. New York–London: Interscience, 1953. 561 pp. $9.50.

Progress in Organic Chemistry, Vol. II. J. W. Cook, Ed. New York: Academic; London: Butterworths, 1953. 212 pp. $7.00.

Films in Psychiatry, Psychology and Mental Health. Adolf Nichtenhauser, Marie L. Coleman, and David S. Ruhe. New York: Health Education Council, 1953. 269 pp. + plates. $6.00.

Nationalism and Social Communication. An inquiry into the foundations of nationality. Karl W. Deutsch. Cambridge, Mass.: M.I.T. Technology Press; New York: Wiley, 1953. 292 pp. Illus. $5.00.

The Logic of Modern Science. J. R. Kantor. Bloomington, Ind.: Principia Press, 1953. 359 pp. $6.00.

In Spite of: A Philosophy for Everyman. John Cowper Powys. New York: Philosophical Library, 1953. 312 pp. $5.00.

Industrial Specifications. E. H. Mac Niece. New York: Wiley; London: Chapman & Hall, 1953. 158 pp. Illus. $4.50.

Les Groupes Sanguins Chez L'Homme: Étude Sérologique et Génétique. Jacques Ruffié. Paris: Masson, 1953. 207 pp. 1.200 fr.

Automatic Digital Calculators. Andrew D. Booth and Kathleen H. V. Booth. New York: Academic Press; London: Butterworths, 1953. 231 pp. Illus. $6.00.

Laboratory Manual for General Botany, Part I. Robert W. Hoshaw, Sanford S. Tepfer, and Barbara J. Peebles. 14 exercises, introduction and glossary. Illus. $2.00. ***Laboratory Manual for General Botany,*** Part II. Robert W. Hoshaw and Sanford S. Tepfer. 14 exercises, introduction and glossary. Illus. $2.00. Minneapolis, Minn.: Burgess, 1953.

Managing Your Coronary. William A. Brams. Philadelphia: Lippincott, 1953. 158 pp. Illus. $2.95.

Experiments and Problems for College Chemistry. 5th ed. J. E. Belcher and J. C. Colbert. New York: Appleton-Century-Crofts, 1953. 214 pp. Illus. $2.50.

Science in Progress, 8th Series. George A. Baitsell, Ed. New Haven, Conn.: Yale Univ. Press, 1953. 285 pp. Illus. $6.00.

Research Operations in Industry. Papers delivered at the Columbia University conferences on industrial research. David B. Hertz, Ed. New York: King's Crown Press, Columbia Univ., 1953. 453 pp. $8.50.

Orchids of Guatemala. Fieldiana: Botany, Vol. 26, No. 2. Oakes Ames and Donovan Stewart Correll. Chicago: Chicago Natural History Museum, 1953. 727 pp. Illus. $5.00; $4.00, paper.

General Botany: Laboratory Manual. John W. Hall. Minneapolis, Minn.: Burgess, 1953. 218 pp. Illus. $3.50.

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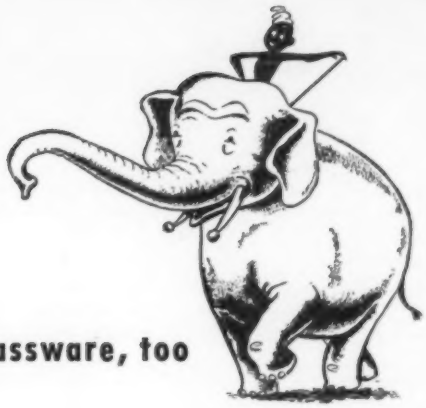

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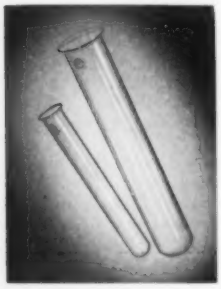

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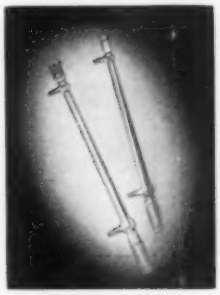

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Publications Received

Clinic on Congenital Amputations. Proceedings of the Kessler Institute for Rehabilitation, Vol. 1, No. 2. Henry H. Kessler, Ed. West Orange, N. J.: Kessler Institute for Rehabilitation, 1953. 35 pp. Illus.

Department of Scientific and Industrial Research. Report for the year 1951–52. London: Her Majesty's Stationery Office, 1953. 293 pp. $1.80.

Geometría Integral en Espacios de Curvatura Constante. Serie Matemática, Vol. 1, No. 1. Luis A. Santaló. Buenos Aires: Comisión Nacional de la Energía Atómica, 1952. 68 pp.

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A Revision of the North American Species of Lathyrus. Biol. Series, Vol. 15. C. Leo Hitchcock. Seattle 5: Univ. Washington Press, 1952. 104 pp. Illus. $2.50.

Sixth Annual Report of the Advisory Council on Scientific Policy (1952–1953). London: Her Majesty's Stationery Office, 1953. 12 pp. 6 pence.

Spray-Type Dishwashing Machines. Standard No. 3. Ann Arbor, Mich.: National Sanitation Foundation, 1953. 46 pp. Illus. 50¢.

Strength of Bamboo (**Dendrocalamus Strictus**). Indian Forest Records, Timber Mechanics Ser., Vol. 1, No. 1. V. D. Limaye. Delhi, India: Manager of Publications, 1952. 17 pp. Illus. 1s 3d.

Sur les Equations du Mouvement de l'Atmosphère Intégrées Suivant la Verticale. Publ. Series B, No. 3. Jacques Van Mieghem. 23 pp. ***Températures de Coexistence de Cristaux de Glace et de Gouttes Salées dans l'Atmosphère.*** Series B, No. 5. L. Dufour and R. Defay. 19 pp. Brussels: Institut Royal Météorologique de Belgique, 1952.

Ten Years of Research, 1943–1953. New York 5: Sugar Research Foundation, 1953. 57 pp.

Transactions of Chemical-Toxicological and Engineering Conferences. 17th annual meeting. Bull. No. 23. 47 pp. Illus. $1.00. ***Transactions of Legal Conference.*** A panel discussion on legal aspects of noise in industry. 17th annual meeting. Bull. No. 24. 49 pp. $1.00. Pittsburgh 13: Industrial Hygiene Fdn. of America, 1953.

Travel Abroad. Frontier formalities, facilities for educational travel. Rev. ed. Paris: UNESCO, 1953. Approx. 300 pp. $4.50.

The Work of FAO 1951–52: Report of the Director-General. Rome, Italy: Food and Agriculture Organization, 1952. 30 pp. Illus. $1.00.

Yale Conservation Studies. Vol. 2, No. 1. New Haven, Conn.: Yale Conservation Club, 1953. 100 pp. Illus. $1.00.

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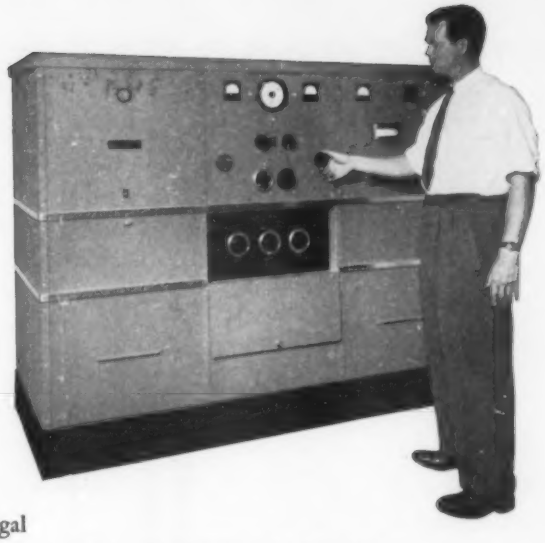

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Meetings & Conferences

Dec. 26–31. American Association for the Advancement of Science. Boston, Mass.
Dec. 27–28. American Folklore Society. Tucson, Ariz.
Dec. 27–30. American Astronomical Society. Nashville, Tenn.
Dec. 27–30. Econometric Society. Washington, D. C.
Dec. 27–30. American Statistical Association. Washington, D. C.
Dec. 27–30. Institute of Mathematical Statistics. Washington, D. C.
Dec. 28. International Union against Cancer. Bombay, India.
Dec. 28–29. Linguistic Society of America. New York, N. Y.
Dec. 28–30. American Anthropological Association (Annual). Tucson, Ariz.
Dec. 28–30. American Philosophical Association. Rochester, N. Y.
Dec. 28–30. American Economic Association. Washington, D. C.
Dec. 28–30. Archaeological Institute of America. New York, N. Y.
Dec. 28–30. Western Society of Naturalists (Winter). Los Angeles, Calif.
Dec. 28–31. American Mathematical Society. Baltimore, Md.
Dec. 29–30. Oregon Academy of Science (Annual). Portland, Ore.
Dec. 28–31. Phi Delta Kappa. Chicago, Ill.
Dec. 29–31. Association for Symbolic Logic. Rochester, N. Y.
Dec. 31. Mathematical Association of America (37th Annual). Baltimore, Md.
Jan. 2–8. Indian Science Congress. Hyderabad, India.
Jan. 4–5. The Mathematical Association (Annual). London, England.
Jan. 9. Wayne University Symposium on Blood (3rd Annual). Detroit, Mich.
Jan. 11–13. Southern Weed Conference. Memphis, Tenn.
Jan. 13. Astronomical Society of the Pacific (Annual). San Francisco, Calif.
Jan. 13–14. American Pomological Society (Annual). Indianapolis, Ind.
Jan. 13–15. American Society of Photogrammetry (Annual). Washington, D. C.
Jan. 13–20. Australian and New Zealand Associations for the Advancement of Science. Canberra, Australia.
Jan. 14. American Genetic Association (Annual Business). Washington, D. C.
Jan. 18–23. Pakistan Science Congress (6th Annual). Karachi, Pakistan.
Jan. 19–22. American Institute of Electrical Engineers (Winter general). New York, N. Y.
Jan. 22. Public Health Workshop on Dental Care in Industry (2nd). New York, N. Y.
Jan. 23–28. American Meteorological Society. New York, N. Y.
Jan. 25–27. American Society of Heating and Ventilating Engineers (60th Annual). Houston, Tex.
Jan. 25–27. Conference on High Energy Nuclear Physics (4th Annual). Rochester, N. Y.
Jan. 25–29. Institute of the Aeronautical Sciences (Annual). New York, N. Y.
Jan. 28–30. High-Speed Computer Conference. Baton Rouge, La.

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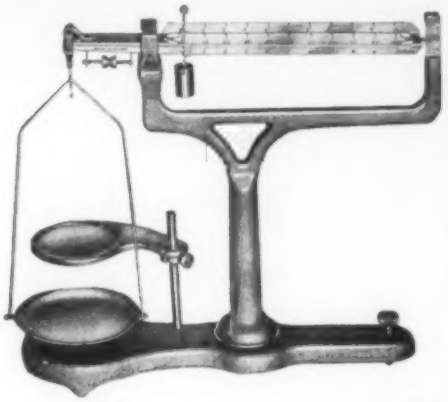

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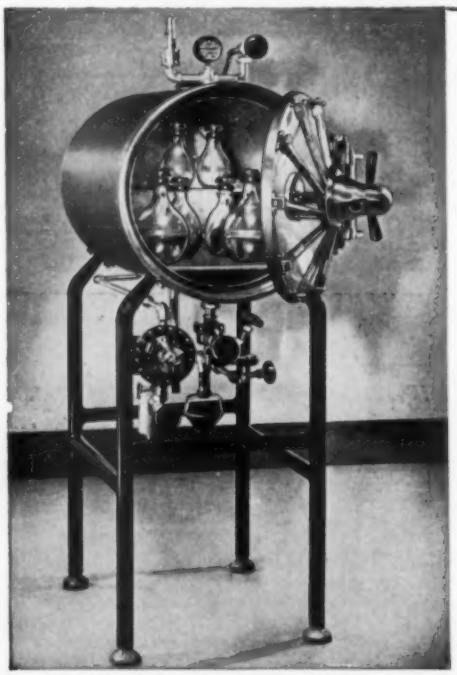

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Assistant: Ph.D. or M.A. in organic chemistry, preferably one with background in biochemistry, organic chemistry and chromatography, research laboratory, middlewest. Science Department, Woodward Medical Bureau, 185 North Wabash, Chicago. X

Biochemist, M.S. or B.S., to $5,400; Analytical Chemist, B.S. and Production Supervisor, B.S. Chemistry or Pharmacy, to $5,200; laboratories, Midwest. Please write Scientific Personnel Service, 122 South Michigan Ave., Chicago. X

(a) Chemist, preferably Ph.D., experienced pilot plant production of synthetic medicinal chemicals; sufficient biochemical background to engage in isolation work on fairly large scale; administrative ability required; East. **(b) Microbiologist** well trained enzymology, qualified conduct independent investigation; key position, research department, chemical company; Midwest. **(c) Biochemist** to direct department 600 bed teaching hospital; man preferred; large city university medical center, Midwest. **(d) Pharmacologist;** duties: teaching of general and clinical pharmacology to medical students and fundamental pharmacology to nurses; university medical school; South. **(e) Physiologist,** M.D. or Ph.D., to join group engaged in surgical and anesthesia research; medical school research department; facilities complete, equivalent to the best. S12-3, Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago.

Pharmacologist, experienced in basic techniques and fundamental background. Pharmaceutical house located in Philadelphia, Pa. C-66, P. O. Box 3552, Philadelphia 22, Pa. X

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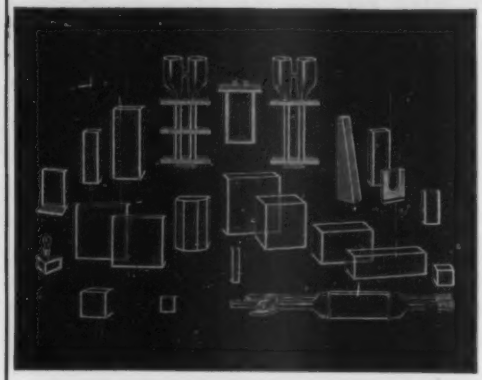

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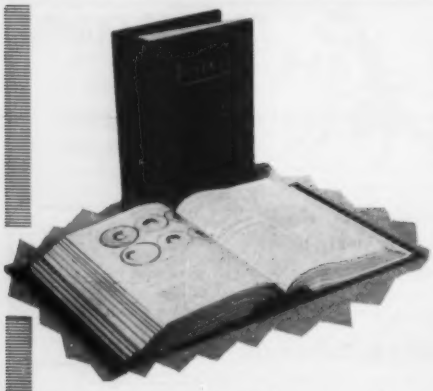

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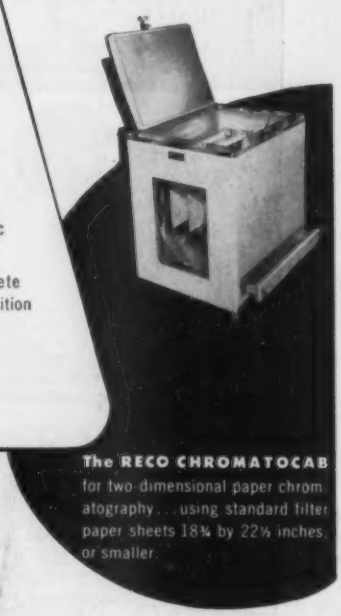

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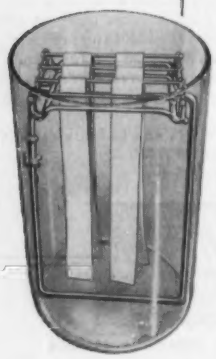

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